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Science Information and the Special Library

By Harold Hugesdon, Librarian, Tape Laboratory, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota.

Future Trends in Plastics

By Richard R. Bruce, Division Manager, Bakelite Company, New York, N. Y.

Emerging Problems in Driver Education

By Amos E. Neyhart, Administrative Head, Institute of Public Safety, Pennsylvania State University, University Park, Pennsylvania.

The RH Factor

By Sister M. Agnese, O.S.F., St. Francis General Hospital, Pittsburgh, Pennsylvania.

The Medical Technologist with a Liberal Arts Background

By William A. Uricchio, Ph.D., Department of Biology, Mount Mercy College, Pittsburgh, Pennsylvania.

The Balance of the Indian Problem

By Magda De Spur, Ph.D., Duquesne University, Pittsburgh, Pennsylvania.

Atomic Energy and the Educational Problems of our Age

By Clark D. Goodman, Assistant Director, Division of Reactor Development, U. S. Atomic Energy Commission, Washington, D. C.

Life, Health and Nutrition

By J. F. Wischhusen, Inorganic Biochemicals, Cleveland, Ohio.

Modern Physics from Journal Articles

• By Sister M. Stephanie, R.S.M., Ph.D.

GEORGIAN COURT COLLEGE, LAKEWOOD, NEW JERSEY

Students tend to depend solely on text books for information and to overlook the wealth of information contained in current periodicals. Sister M. Stephanie's course in modern physics uses articles from current journals as the core of the course.

This article describes the prerequisites, content, and methods used in this course. We would like to present to our readers accounts of similar experiments in high school and college teaching.

Among the aims of science teaching in a liberal arts college are the making of the student aware of the world about him, appreciative of God's wonders of creation, and conversant with the topics of the day that relate to scientific knowledge. Lip-service, at any rate, is always given to these rather intangible aims, although in practice one may often lose sight of them and concentrate on the more urgent and immediately necessary objective of presenting an organized body of information to the student for his rapid consumption and assimilation so that he may use it for whatever work he intends to do.

An attempt was made last year to fulfill the first mentioned aims (without, however, neglecting the last objective) in a course in modern physics taught largely through the use of periodical articles, rather than with complete dependence on a textbook.

The college, a liberal arts college for women, offers an elective, three-hour, one semester course entitled *Introduction to Modern Physics*. This is a lecture course with no laboratory work required, although laboratory demonstrations often accompany lecture material. No major program in physics is offered so that those girls who elect the course have as their major subject either mathematics or chemistry. Many will be high school teachers, some will go to graduate school, some will work in industrial laboratories, all will be citizens of tomorrow's world. All of these girls need to know about and be able to discuss intelligently the structure of the atom, x-rays, betatrons and cyclotrons, television tubes, and radioactivity. All do not need to know, in intricate detail, about Fermi-Dirac statistics.

Prerequisites are one year each of general chemistry and general physics. Those taking the course are juniors or seniors and in almost all cases have also had other laboratory physics courses in electricity, mechanics, and so forth. The course is described in the college catalog as an "introduction to the concepts of atomic physics, including a consideration of the atomic nature of matter, discharge tubes, radiation, x-rays, cosmic rays, radioactivity and quantum theory." This is a formidable list of topics even to be mentioned in

one semester much less to be discussed exhaustively. Modern physics textbooks such as those by Jauncey or Hull are more than adequate for they contain a wealth of material^{1,2}. Twice the course was taught using Hull's *Elementary Modern Physics* as a text, and various supplementary readings from current periodicals were assigned. The third time a new plan was tried which seemed more fruitful in the attainment of the objectives mentioned above, and the purpose of this article is to describe that attempt.

The new plan was to use articles from current journals as the core of the course, and to refer to the text chiefly to supply background factual material for the periodical articles. Largely, articles from the *Scientific American* were chosen, but others from *Physics Today*, *Science*, *Bulletin of the Atomic Scientists*, and the *American Journal of Physics* were also used. A set of bound copies of the *Scientific American* from 1948 to the present is readily accessible in the classroom, as are many duplicate unbound issues. Articles are assigned several weeks in advance of class time and the class groups are sufficiently small that there is ample opportunity for the readings to be done. The students keep notes on their readings but prepare no formal written report, except rarely, to be presented to the instructor. During the class period a seminar plan is most frequently followed with the time used for discussion of material already prepared by the students. The instructor usually leads the discussion and frequently asks questions to insure that the most important points have been comprehended. If the material is particularly difficult, the instructor may give a lecture on it first as new work before any reference is made to a journal article. Occasionally the same material is studied from a standard text and from a periodical article, and the aspects under which is treated are compared.

In the handbook *Science Reasoning and Understanding* there is a comparison made between textbook material and a current science article:

A textbook is usually written dogmatically in order to present the most compact and complete organization of a subject appropriate to the level of the students to whom it is addressed. Instead of pointing out problems and how they have been attacked, it goes directly to the final conclusions and generalizations which most concisely solve problems that may have once existed. This concise presentation of scientific information is predicated on the assumption that the memory of such knowledge is the primary objective of teaching in science. If, on the other hand, additional objectives are sought for, such as an understanding of how science knowledge has been obtained or an appreciation of the point of view of a scientist and what he does, then textbook materials must be supplemented.

It (i.e., an article from current literature) generally reports quite recent developments of current research, more recent than those which usually find their way into standard texts. It commonly pro-

vides a background in early history with the purpose of presenting a more comprehensive view of the whole problem, including many of the steps in the development and accounts of some of the exciting experiments associated with these steps³.

Articles in current periodicals, for example, those in the *Scientific American*, lend themselves admirably to study in a course of this type because they are written with clarity and interest and forcefulness, yet with the necessary scientific accuracy. They are written by experts in the field, and while they do not sacrifice precision or scholarship to popularity, they do bring weighty concepts within the comprehension of the average college student. Who, to take one example, would know more about the synthetic elements than Glenn T. Seaborg, writing on that subject in the April, 1950, *Scientific American*⁴? The articles are "meaty" and cannot be read hurriedly and absorbed and then reproduced the next day any more than a textbook chapter can. They need careful scrutiny, frequent additional textbook reference on the same subject, sometimes a reference to the short selected bibliography provided with each article or to a different reference suggested by the instructor. The illustrations are fascinating and the line drawings larger and more detailed than those in any text. Where could one find illustrations of a mass spectrometer to match those in the March, 1953, issue of the periodical mentioned?

A student needs to read carefully with a pencil in hand, but when she has finished only one article she will have an insight into the major developments, and the most modern developments of a particular topic. She will have learned the historical approach to the problem, the various false starts that were made toward its solution (which do not find their way into textbooks), and the relation of this problem to others. No publisher can afford to bring out a new edition of his text every time there is a new discovery in a constantly expanding subject, but a periodical, by its nature, must keep abreast of each new development. Hull, in his preface, says that "if it is a textbook in physics, it is not modern⁵."

Finally, one wished to inculcate into college students the habit of good reading so that this may be carried over into later years. The habit of reading scientific periodicals, even semi-popular ones, is good and is one that will grow with the passing years. The reading of these and more especially of the more scholarly research journals will be an absolute necessity if the student follows a professional career. Where better to begin? We speak so often of the values of a general education, of the worth of good reading, of a common meeting ground for the specialist and non-specialist. *Introduction to Modern Physics* is not intended as a course in general education, but a very few of those following the course will be research physicists, and they will take many more physics courses in graduate school before they reach their goal. The majority of the students enrolled in it do need it for general information, specifically for a literateness in the terms of modern physics used so frequently today, or to pass on to those high school students whom they will teach, their enthusiasm for the subject. Here is the place for

the future teachers of high school science to learn the process by which scientific facts are discovered, to learn to evaluate clearly and distinguish among those things that are known with certainty, those that lie in the realm of conjecture with good evidence, and those that are yet to be discovered.

On the other hand, there may very well be objections to a course planned in this way. There is mathematical treatment of certain topics that must be included if the course is to deserve its name, and this treatment is lacking in semi-popular journal articles. It must be supplied from a textbook or by the instructor. On some subjects such as isotopes, counters and fission particles there are many available and useful articles in the *Scientific American*, and on other subjects which must be included, as Millikan's oil-drop experiment and the measurement of the ratio of charge to mass in an electron, there is no particular article that just fits the case. In this instance the chapter of Millikan's autobiography describing his experiment was used, and the ratio of charge to mass was studied from the textbook⁶. Often all the material needed in order to conform to textbook presentation is available in the periodical articles, but not all in the same article. For example, in the article on "Quantum Theory," there is mention of black body radiation (in reference to the origin of Planck's theory through thermodynamics), discussion of Planck's constant, an explanation of the photoelectric effect, and material on the Compton effect⁷. Almost all textbooks consider the Compton effect in a chapter on x-rays, but perhaps it could more naturally be considered in an historical context with the quantum theory.

The method of studying in detail journal articles and placing emphasis on them owes its origin in part to Conant's hypothetical general education course on The Tactics and Strategy of Science as described by him in *On Understanding Science*⁸. He suggests outlines of certain case histories to be studied in science but from an historical point of view, so that the layman might better learn of the spirit of science and how these discoveries came to be. The method of presentation of modern physics as described in this paper differs from Doctor Conant's plan in many ways but chiefly in the fact that he recommends that a few topics be studied in detail, and the course here described must necessarily touch upon many topics with little time for deeply detailed study. During the semester the students write one rather long term paper on a subject of their choice and in this manner they do become quite familiar with the fine points of at least this one topic. Suggestions for the subjects of term papers are made, but need not be strictly followed. Some excellent papers have been produced.

In another set of circumstances—larger classes, for example, or a need on the part of students for a strict mathematical treatment of the subject—this plan might not be desirable. But this time the method did seem successful in establishing "some feeling of physics as a type of endeavor, as a mode of thought—in providing some insight into those aspects of the activity which are relevant to their (the students, i.e.) life and times."

The following are some of the periodical articles that were used. The list is by no means exhaustive. Many other articles from other journals could equally well be used.

The Electron

Millikan, R. A., "My Oil Drop Venture", *Autobiography of Robert A. Millikan*, New York: Prentice Hall, 1950.

Millikan, R. A. Electrons (+ and -), Protons, Photons, Neutrons, and Cosmic Rays, Chapters I to V. Chicago: University of Chicago Press, 1937.

Positively Charged Particles; Mass Spectrograph

Born, Max. "Physics," *Scientific American*, Sept. 1950, p. 28.

Nier, Alfred. "The Mass Spectrometer," *Sc.A.*, Mar. 1953, p. 68.

Yagoda, H. "The Tracks of Nuclear Particles," *Sc.A.*, May 1956, p. 40.

Photoelectric Effect; Quantum Theory

Darrow, Karl K. "The Quantum Theory," *Sc.A.*, Mar. 1952, p. 47.

Thermionic Effect

Pierce, J. R. "Electronics," *Sc.A.*, Oct. 1950, p. 40.

Ridenour, Louis N. "Revolution in Electronics," *Sc.A.*, Aug. 1951, p. 13.

Sparks, Morgan. "The Junction Transistor," *Sc.A.*, July 1952, p. 37.

X-Rays

Kirkpatrick, Paul. "The X-Ray Microscope," *Sc.A.*, Mar. 1949, p. 44.

Compton, A. H. and Allison, S. K. *X-Rays in Theory and Experiment*, Van Nostrand, 1946.

Electromagnetic Waves

Ayres, Eugene. "Power from the Sun," *Sc.A.*, Aug. 1950, p. 16.

Rush, J. H. "The Speed of Light," *Sc.A.*, Aug. 1954, p. 62.

Smith, N. "Color Television," *Sc.A.*, December 1950, p. 13.

Natural Radioactivity

Eve Curie, *Madame Curie*, New York: Doubleday, 1938.

Deevey, Edward S. "Radiocarbon Dating," *Sc.A.*, Feb. 1952, p. 24.

Hurley, P. M. "Radioactivity and Time," *Sc.A.*, Aug. 1949, p. 48.

Kerr, Paul F. "The Earth's Uranium," *Sc.A.*, May 1951 p. 17.

Elementary Particles, Methods of Detecting, Methods of Accelerating

Bethe, Hans. "What Holds the Nucleus Together," *Sc.A.*, Sept. 1953, p. 58.

Collins, George B. "Scintillation Counters," *Sc.A.*, Nov. 1953, p. 36.

Courant, Ernest. "A 100 Billion-Volt Accelerator," *Sc.A.*, Nov. 1953, p. 36.

Hofstadter, Robert. "The Atomic Nucleus," *Sc.A.*, July 1956, p. 55.

Korff, Serge A. "Counters," *Sc.A.*, July 1950, p. 40.

Marshak, Robert. "The Multiplicity of Particles," *Sc.A.*, Jan. 1952, p. 22.

Mayer, Maria. "The Structure of the Nucleus," *Sc.A.*, Mar. 1951, p. 22.

Morrin, Philip. "The Neutrino," *Sc.A.*, Oct. 1951, p. 44.

Morrison Philip. "The Neutron," *Sc.A.*, Jan. 1956, p. 58.

Panofsky, Wolfgang. "The Linear Accelerator," *Sc.A.*, Oct. 1954, p. 40.

Smith, Lloyd. "The Bevatron," *Sc.A.*, Feb. 1951, p. 20.

Weisskopf, Victor. "A Model of the Nucleus," *Sc.A.*, Dec. 1955, p. 84.

Artificial Radioactivity

Cox, Everett. "Atomic Bomb Blast Waves," *Sc.A.*, Apr. 1953, p. 94.

Flagg, John. "Atomic Pile Chemistry," *Sc.A.*, July 1952, p. 62.

Ghiorso, Albert and Seaborg, G.T. "The Newest Synthetic Elements," *Sc.A.*, Dec. 1956, p. 64.

Hofstead, Lawrence. "Reactors," *Sc.A.*, April 1951, p. 43.

Hughes, Donald. "The Nuclear Reactor as a Research Instrument," *Sc.A.*, Aug. 1953, p. 23.

Jordan, N. H. "Radiation from a Reactor," *Sc.A.*, Oct. 1951, p. 54.

Kamen, Martin. "Tracers," *Sc.A.*, Feb. 1949, p. 30.

Lovewell, Paul J. "The Uses of Fission Products," *Sc.A.*, June 1952, p. 19.

Perlman, I. and Seaborg, G. T. "The Synthetic Elements," *Sc.A.*, Apr. 1950, p. 38.

Seitz, Frederick. "The Effects of Radiation on Solids," *Sc.A.*, Aug. 1956, p. 76.

Schurr, Sam H. "The Economics of Atomic Power," *Sc.A.*, Jan. 1951, p. 32.

Spoerl, Edward. "The Lethal Effects of Radiation," *Sc.A.*, Dec. 1951, p. 22.

Weinberg, Alvin. "Power Reactors," *Sc.A.*, Dec. 1954, p. 33.

Cosmic Rays

Gray, George W. "Cosmic Rays," *Sc.A.*, March 1949, p. 28.

(Continued on Page 71)

The Bell Solar Battery

• By Harold A. Byron

SUPERVISOR—CUSTOMER INFORMATION, THE BELL TELEPHONE COMPANY OF PENNSYLVANIA

The Bell Solar Battery is the most successful device for converting solar energy directly to useful amounts of electrical energy, but before it can compete with conventional sources of energy a great amount of fundamental research is needed.

The author discusses the principles on which the Bell Solar Battery operates, its construction and possible future.

As all of us know the sun is the ultimate source of energy. No one would be able to live in this world nor would there be any plant life here on earth were it not for the sun. Furthermore, the sun not only provides light and heat but, over the centuries, it has also provided us with the coal and oil which today are our principal sources of power.

Its potential as a source of energy is almost beyond human comprehension. In fact, it has been estimated that there is enough energy in the sun to provide man with all the heat, light and power he will need for the next two billion years; and, although the earth receives but a tiny fraction of this energy, this fraction adds up each year to the amount of energy that could be produced by, 122 trillion tons of bituminous coal. In a single day, even when the sun may not appear to be shining, just two square miles of land or sea will absorb from the sun, energy equal to the awesome power released by the explosion of an atom bomb.

Unfortunately, although the sun supplies over a thousand trillion kilowatt hours of energy daily—an amount of energy comparable to all the known reserves of coal, oil, natural gas and uranium on earth—man has never been able to convert more than a small fraction of this energy directly to his use.

It is true, of course, that over the years there have been numerous attempts by scientists to use the energy from the sun directly. As a matter of fact, there are many such installations all over the world which, by means of mirrors and lenses, concentrate the rays of the sun on various devices to produce heat. Ordinarily, however, such uses are quite uneconomical and can be of advantage only in special cases where power from coal, oil or water is not readily available. There have also been efforts to use the tides of the ocean, using the thermopile principle as a source of power but these also have proved to be uneconomical under ordinary conditions.

It is not surprising, therefore, that when the Bell Telephone Laboratories, the research organization of the Bell System, announced its development of the Bell Solar Battery, it received a great deal of public

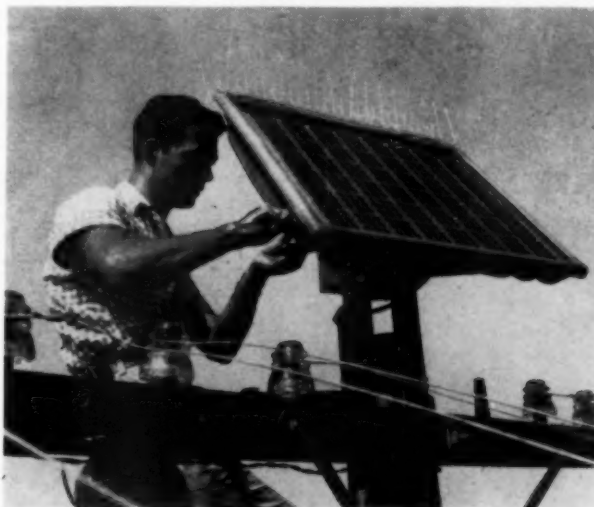
attention, for here was the first device ever developed that would successfully convert *useful* amounts of the sun's energy directly and efficiently into electricity.

When it was first announced in April 1954, the solar battery's efficiency in converting light into electrical energy was about 6%. Today, that same ratio of efficiency, through continuing research and experimentation, has been increased to 11%—a ratio, incidentally, which is not only nearly twice that originally achieved but which compares favorably with the efficiency of the average gasoline and steam engine. Ultimately, it is believed that the efficiency of the battery can be increased to as much as 20%.

Technically, the Bell Solar Battery is a surprisingly simple device consisting primarily of a number of individual solar cells in the form of disks about one inch in diameter which can be linked together to deliver power at the rate of 100 watts per square yard of effective surface. The principal ingredient is a mineral called silicon, found in one of the most plentiful substances on earth—common sand.

Now that doesn't mean, of course, that to make a solar battery all that is necessary is a handful of sand. On the contrary, the processing involved is quite intricate, chiefly because the silicon used in the solar battery must be refined and purified until the proportion of unwanted impurities is less than one part in ten million. This ultra-pure silicon is refined through a process known as "zone-refining."

The next step in making a solar battery is, strangely enough, putting back into this silicon certain selected impurities.



BELL SOLAR BATTERY
Used in Americus, Georgia, Experiment

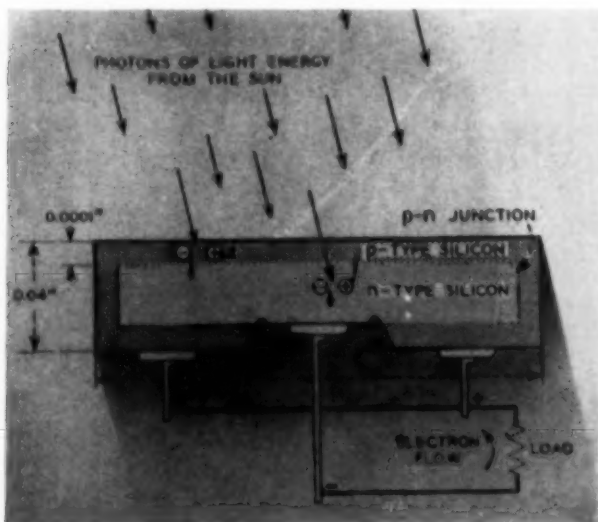
Pure silicon, which appears in the fourth column of the periodic table is relatively nonconductive. However, if some element from the fifth column such as arsenic is added as an impurity, in the proportions of one part arsenic to one million parts of silicon, a semiconductor with an excess of free negative charges or electrons can be obtained because at every appearance of an atom of arsenic with its five electrons combining with the silicon with its four electrons will produce free electrons. Conversely, by adding some element, such as boron, from the third column of the periodic table, a semiconductor with an excess of free positive charges, or "holes," is obtained. These semiconductors are known as n-type and p-type, respectively.

The body of the solar battery is the n-type silicon which is formed by melting the silicon and arsenic together, from which a small single crystal ingot is pulled. This ingot is cut into wafers to the size of the cells used in making the solar battery.

The wafers are next heat-treated with boron in an electric vacuum furnace at 1300°C. At this temperature the boron diffuses into the surface of the wafer and this penetration is controlled to 1/10,000 of an inch. It is this control of the boron that is the most important step in making the battery.

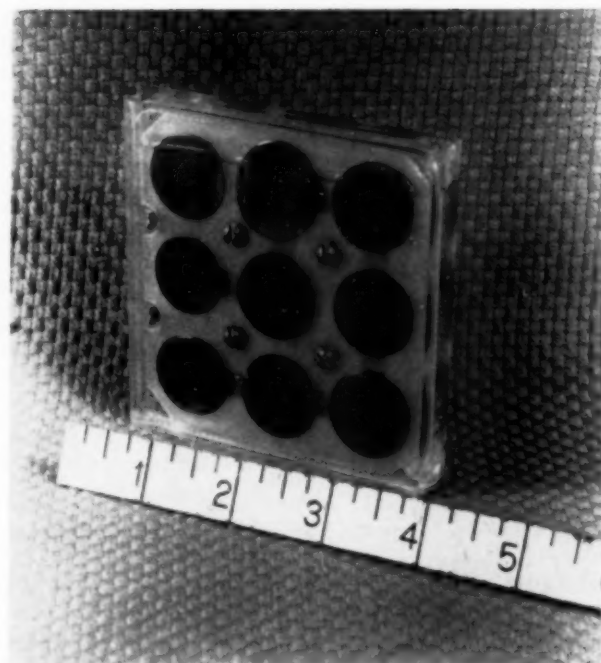
The junction or meeting point of the n-type (arsenic doped silicon) and the p-type (boron doped silicon) segments is known as the "pn" junction and is the heart of the solar battery. This junction is made up of hole-electron pairs and forms a barrier between the n-type and p-type segments thus preventing the free flow of excess electrons and "holes" back and forth between their respective segments, and tending to keep the electrical charges in a free or unbound state.

We now have our free electrons and holes in the solar battery and in order to induce an electric current it is necessary to set these in motion. And so the ques-



CROSS SECTION OF SOLAR CELL showing p-n junction and creation of electron-hole pairs by photons of light energy.

FORTY-SIX



SINGLE UNIT OF SOLAR BATTERY

tion still remains, however,—how does all this serve to convert light into electricity? Light, of course, is an electro-magnetic wave—the same sort of wave that is used for ordinary radio or television broadcasting, except that the wave length of light effective on the solar battery is extremely short—75/100 microns in length. Light also has in it energy—similar to the energy in the radio wave that activates a radio receiver. The energy in light is measured in terms of a unit called a "photon" and the definition of a photon is: Enough energy so that, when it strikes an atom it will tear one positive and one negative charge away from that atom. Now this action is not "nuclear fission" as in the atomic bomb where tremendous amounts of energy are liberated and an enormous explosion results. Nevertheless, when sufficient light hits the Bell Solar Battery, positive and negative charges are torn away from the silicon atoms.

In effect, as light is absorbed in the region of pn junction, electron-hole pairs are formed and are attracted to their respective segments of the solar battery which creates a voltage difference, or difference in potential causing free electrons to flow when the circuit is closed.

Two features of the Bell Solar Battery are of particular interest—the fuel it uses is free and, so far as is known today, its life is unlimited for nothing is consumed or destroyed in the energy conversion process, and there are no moving parts.

Already practical applications of this device have been effectively demonstrated in the telephone business in the course of an experiment successfully com-

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Science Teaching and the Science Teacher

• By Andrew A. Sherockman, Ph.D.

FORMERLY OF EVANSVILLE COLLEGE, EVANSVILLE, INDIANA

Science courses taught in a routine and static manner destroy the students' interest in science.

The author analyzes the present state of science education, the preparation of science teachers, and the philosophy of science teaching.



This paper is concerned primarily with the present state of science teaching and with the difficult problems to be faced. What are the facts which tell us what is happening in science teaching? What can the science teachers do jointly to improve that which needs improving? Perhaps science education in your schools is better than average, perhaps it is poorer.

No doubt, there are many things in the state of educational affairs that need improvement. As educators we should be aware of, and deeply disturbed by them. However, there are many things that are good. Past achievements lead us to believe that further improvements can be made. Citizens everywhere should be dedicated to the ideal of providing schools for all children, so that they may enjoy equal opportunity to develop their capacities to the full. Yet what concerns us here is that one of the areas of pending failure, at a time when success is most vital, is science education.

The basic instructional pattern was set in the mid-nineteenth century for the select few who then attended high school. Since then, the changing characteristics of the high school population have required changes in this pattern. While there exist differences of opinion as to what changes would be most desirable, there is widespread feeling that present instruction in science is inadequate for the range of interests and abilities inherent in the students.

General Science and Biology are the only sciences experienced by a greater number of high school students. Chemistry and Physics are taken by a smaller group of students. At present we are failing to make science in its broadest sense attractive to the high school students. The slow student is soon discouraged, while the rapid learner is quickly bored.

The term "atomic age" no longer belongs to science fiction, nor is it merely a cliché; it describes a reality. In the scientific and technological culture of our present-day society, every citizen needs a realistic understanding and appreciation of the role that science, both biological and physical, plays in everyday life. Of comparable importance are also the developments of understandings and skills which function in a wide encouragement of scientific abilities needed in engineering, research, teaching, ministry, and other professions.

One phase of the problem is the need for educational flexibility. The curriculum for many of our high schools is organized and administered toward the goals of general education. Each school has its own peculiar statement of educational philosophy. With this philosophy it is assumed that all science teachers are directing their attention toward the problem of seeing to it that science instruction fulfills the aims of general education.

The main purpose of science education, after all, is to advance human understanding. Despite this high purpose too few high school students are being led to study it. The true purpose of education should not be to make living textbooks, but to do what Socrates proclaimed, namely, to achieve independence and spiritual self-reliance. The true purpose of science always has been and should remain to serve mankind and not to dominate it.

Joel Hildebrand, Emeritus Professor of Chemistry, University of California, aptly stated the purpose of education. "Acquisition of knowledge is the aim of education. Gaining facts gives the basis for advances in science. But education must be more than an activity for accumulation of facts; it must show how successful problem solvers think and work."

Preparation of Science Teachers

The quality of our science teachers is crucial, for these teachers create the atmosphere and viewpoint within which the teaching influences the development of the students. Buildings, equipment, curricula, books, and administration are only aids to better teaching. Unless the teacher has the intellectual and emotional maturity, the vision and ability to utilize these aids effectively the teacher cannot arouse desired ideas and attitudes in the student. Motivation cannot be stimulated, it cannot be aroused, it must come from the learner's heart.

What is the quality of a science teacher? Teaching is an impersonal process which requires an understanding of, an interest in, and an active desire to help students grow to their fullest potential. Another valued quality is the stimulating influence upon the student; one great quality is to inspire the student to think for himself. A quality teacher will express to students the significance of the subject in addition to the subject matter itself. A quality teacher will inspire confidence, challenge student interest, and lead effectively only as he is himself master of his subject matter field. The quality science teacher is as well prepared in the subject field as he is in how to teach and the methods he uses to teach. An important quality that is often taken too lightly by teachers is the organization of materials and careful preparation for each class meeting.

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Anthropology

• By **Lawrence Hugo, Ph.D.**, (University of Pittsburgh)

ASSOCIATE PROFESSOR OF SOCIOLOGY, DUQUESNE UNIVERSITY, PITTSBURGH, PENNSYLVANIA

Anthropology had its origin in the natural sciences. It seeks to obtain precise knowledge of the relationship of the biological and physical characteristics of man to the behavior of man. It attempts to explain behavior, but can not set up norms for behavior.

The author discusses the nature of anthropology, and its relationship to the physical and social sciences.

Anthropology, like the rest of the social sciences, was born in the humanitarian and rationalistic age of the eighteenth century. Previous to this time there was really no organization and practically no all-out effort to understand man and the society in which he lived. The intellectual salons of Paris and London allegedly freed by a new theism or atheism turned with the fanaticism of a reformer to the new god, Humanity, to the new cult, Man. Alexander Pope aptly put this intellectual tone in verse:

Know then thyself, presume not God to scan,
The proper study of mankind is man.

Sociology, economics, political science, anthropology—these are the social sciences, the studies that direct their attention specifically to mankind. They have gone a long way since the seventeenth and eighteenth centuries. There has been much more written, much more found, much more guessed since the writings of Buffon, Boucher de Perthes, Darwin, Comte, Hobbes, Bentham and Smith. The social sciences are now an integral part of every educational system, lodged, not quite as securely, but nonetheless lodged side by side with the natural sciences and the humanities. There has developed a hierarchy of status and an unrealistic fragmentation among the disciplines. There is jealousy, intrigue and duplication among the disciples. There is much discussion about "areas" or "fields" of study. Such division of labor in the intellectual adventure is quite necessary, but carried to the extremes that it has been carried, it has led in many ways, to a sort of Tower of Babel . . . which leaves our young students quite bewildered.

However, these are the divisions we have, and these are the divisions we must presently work with. Our point of interest is the division of the social sciences, and within this, the study known as Anthropology. The word quite simply means the study of man, for the Greek words *anthropos* (man) and *logos* (study). The study itself is not quite so simple, and understandably, because man is not simple. In many ways every thinking individual is some sort of anthropologist. We are certainly interested in ourselves and those around us. We are interested in the many variations of physi-

cal appearance and in the many variations in behavior—in dress, in food habits, in language, in religion, in art and in every aspect of human living.

Such interest does not make either anthropology or the anthropologist. It is merely the basis for this study. When such interest is followed by efforts to organize and systemize ways of studying man, of collecting data regarding man, of determining the significance of such data, or of its relationship with other information previously gathered, it was then that we have Anthropology, or the true science of man. If there is no such organized thinking and searching then there is mere dilettantism, a pleasant pastime but in no way fruitful in the understanding of man.

In the past ninety or hundred years, the science of man has become an accepted and respected member of the family of sciences. In the past thirty years, we find more and more of our colleges and universities setting up independent departments of anthropology or offering a representative number of courses together with sociology. As an independent department it is better equipped to train more future anthropologists or patrons in the field. Combined with sociology it is adequately equipped to give the young student an excellent insight into man and his works and a good foundation for independent study.

The science of man, the study of the ways of man, the study of man and his works, anthropology, all of these have been used by men in the field to label the discipline. If we are to study man, we must study him from two general points of view: he is an animal, thus from the biological; he is a social animal, thus from the social. We must examine man as a biological organism just as we examine the dog or the cat. We must examine him as an organism that is highly organized socially, and one that makes and uses tools and products and culture. Common sense tells us that our physical and biological make-up is related to our overt behavior. Common sense tells us but not precisely. Anthropology seeks precise knowledge of this apparent relationship. It follows then that the study of anthropology would be divided into two main divisions: physical anthropology and cultural anthropology.

Physical Anthropology

Physical anthropology is the study of the physical characteristics of the human species. It is simply human biology, for it studies man the animal. Its interest lies mainly in the origin, evolution and the present nature of man's physical characteristics. In dealing with prehistoric man the physical anthropologist must seek out and work with skeletal remains, fossilized and unfossilized. Osteology is the word applied to the study of the bony or skeletal structure of an organism. The specialties of human evolution and

human paleontology concern themselves with the prehistoric development of man by studying and comparing the skeletal remains of manlike animals.

The physical anthropologist has a much easier task in dealing with the living races of man. This study of living man is simply the study of race. The subdivisions of racial study are many. Human ontogeny studies the physical changes of the human organism from birth to death. Anthropometry is the science of measuring the human organism, such as the head, stature, arm and leg lengths, etc. These measurements are generally treated statistically in terms of averages, indices, ranges of distribution, and comparisons for different populations. Attention is given to the internal or physiological make-up of the human organism. The problem of basal metabolism, pulse rates, growth rates, sex differences and many others are examined comparatively in different populations. When the findings of such data are organized statistically we have a branch of study known as biometrics.

This is physical anthropology, a study that seeks to know as much as possible about the physical thing called man. There is no question that the physical make-up of man has a great deal to do with his cultural make-up. True, he is not narrowly circumscribed in his activities by his physical make-up such as is the case among the infrahumans, but he is limited, to a greater or lesser degree by the fact that he is an animal, and that his culture should be guided and tempered by this fact. And finally, there can be no true understanding of man and his behavior, which we call culture, unless we first have a clear knowledge of his physical make-up, his limitations and his range as an adaptive organism.

Cultural Anthropology

The one concept that directs the entire study of anthropology is that of culture. The clarification and definition of this concept is the contribution of anthropology to modern thought. Culture is conceived as the totality of learned patterns of behavior which are characteristic of a given society. The study of these learned patterns of behavior is the subject matter of cultural anthropology. Historically cultural anthropology concerned itself with the study of so-called primitive peoples, but at present the cultural anthropologist believes that all cultures are his subject matter, whether primitive or modern, contemporary or extinct. No longer should we picture the anthropologist as a student of primitive or past societies only. His mission is the understanding of culture and this understanding can be arrived at only by studying every conceivable form of culture both in time and in space. He is a student of the contemporary scene, he is a historian of the past and, as an archaeologist; he is an analyst of the prehistoric past. All data regarding the organization of human behavior from any one of the periods will considerably enhance the success of understanding culture.

Cultural anthropology, therefore, concerns itself with the origin and history of many cultures, their evolution and development, their structure and function.

It is historical, comparative and empirical. It is easily seen that such a study necessarily covers a rather tremendous field. Here is a large order for any field of study. It was inevitable that there would develop a breakdown or a sub-division of the field of cultural anthropology. The two main divisions are known as Ethnology and Ethnography. Ethnography is simply the descriptive study of a culture. It answers the question *what*. It gives a picture of a given culture without interpretation or speculation. It is comparable to geography which is descriptive of the earth. There are those who presently believe that ethnography as a distance field is fading out. Ethnology is in ascendancy. This is the theoretical, speculative, interpretive study of culture. This field takes the data of ethnography and seeks to extract meaning from it. Ethnology asks the question *why*. In other words, ethnography in itself might make interesting reading, but ethnology makes interesting, informative and provocative reading. It not only describes a certain custom of a given people it also explains *how* this custom came about, whether it was independently invented by these people, whether it was borrowed (diffusion) from another society, or whether it is a combination of many customs from many societies. *How* a certain custom came about is no more important than *why* it came about. This constant gathering and analysis of cultural data aims at the formulation of principles that will apply to all cultures and to all people. This is the mission of science; this is the mission of ethnology as a distinct field of anthropology.

Besides the two main divisions of cultural anthropology we find that it has like every other discipline proliferated into a number of other specialties. Archaeology is the study of extinct cultures, seeking to reconstruct these cultures and societies in historical chronology. The archaeologist is limited in his study to the material remains of such cultures. Such cultural remains can be gathered largely by the excavation of past human settlements. The science of archaeology, relatively new, has gathered an enormous amount of data, and by the deduction, or as Herskovits terms it, "scientific imagination", has given us reconstructed pictures of ancient civilizations such as the Sumerian, Egyptian or Mycenaean cultures. Another field is that of *Linguistics*, the science of language. Language being the principal medium of cultural behavior and transmission must be of prime interest to the student of culture. As a cultural fact, language can reveal not only mental habits, motivations and interests of a people, but also, by comparison, we can possibly learn the origins both of a people and their culture. Language can be an invaluable roadmap in the tracing of a culture's or a peoples' origins. Thus, the systematic analysis of language forms and functions, with the comparative study of languages, makes up the science of linguistics.

This is the general breakdown of the field of anthropology. There are many sub-specialties, developing as the need for deeper or more concentrated study arises. There is a great deal of overlapping into other disciplines, for the culture of man cannot be limited to

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Careers in Pharmacy

• By **Robert A. Hardt, Phar.D.** (*Rutgers University*)

VICE PRESIDENT, HOFFMANN-LA ROCHE, INC.; PRESIDENT, NATIONAL PHARMACEUTICAL COUNCIL, INC.

To most of us the pharmacist is one who spends his life behind the counter of a retail pharmacy, and few realize the variety of careers open to the pharmacist.

The author, a leader in the profession of pharmacy discusses the careers open to members of this ancient and highly respected calling.

Recently I enjoyed an unexpected laugh when I came to the end of a report by Doctor Edward Gillespie on "Medical Students and Motivations¹." The final observation, preceded by six rather discouraging conclusions, was "Motivation studies are very upsetting."

Quite apart from the motivation of medical students, it is upsetting for many of us in the profession of pharmacy to realize that youngsters in the elementary schools have not been successfully motivated by us or our associations and our colleges of pharmacy to prepare themselves with background knowledge in mathematics and science—definite prerequisites to college courses in pharmacy, chemistry and pharmacology.

However, there is hope in the knowledge that professional people in all branches of medical science are now recognizing the need to modify the trend of thought which leads teenagers to consider high school the end of formal education, rather than a springboard to professional careers and achievements which will contribute to our public health and welfare and strengthen our national security and economy.

It is encouraging also to note editorial comments which point to a good beginning in the efforts of those in industry and government to stimulate the interest of youngsters in physical, chemical and physiological phenomena. In one of a series of editorials prepared by the McGraw-Hill Department of Economics², it was pointed out that "Much is being accomplished already in efforts to attract more young people into scientific and engineering careers . . . Other notable contributions are being made by such organizations as the professional engineering and scientific societies (especially through their manpower commissions) . . . But only with wider appreciation of the serious implications of the shortage of scientists and engineers and intensified efforts on the part of business, government and education to relieve the shortage can we hope to overcome this threat to our national security and economic well-being."

The American Association of Colleges of Pharmacy has collected some very interesting questions and answers in a booklet called, "Shall I Study Pharmacy³." The information in this little publication is particularly valuable because it comes from highly authoritative

sources. For instance, "To find out what prospective students want to know about pharmacy, we asked a few hundred high school seniors and some pharmacy freshmen for their ideas." And these are discussed by the leaders in pharmacy education with help received from professional people active in all phases of pharmacy.

It is not easy for any one individual to provide informative answers to blunt questions by impatient youngsters who want to know, "What is the starting pay?" "What are the hours?" and, "How soon can I expect advancement?"

Payroll statistics obviously do not provide valid answers because average figures do not reflect the economic variation in different communities. But the charts do show evidence of a high standard of living; and talented young pharmacists are sure to receive starting salaries which are high enough to remind them that they are embarking on a professional career; and they will earn more than enough to maintain a social position in keeping with their new important role in the community. Working hours are no longer, and perhaps shorter, than required of other professional people who have equally significant positions. And as for promotion, few professions can surpass pharmacy in opportunities for advancement.

My own experience in pharmacy has been varied, interesting and rewarding in the retail field, as a member of a State Board of Pharmacy, professional sales representative, division sales manager, and in executive and administrative work in pharmaceutical industry.

My experience, incidentally, is far from unique. Furthermore, professional-minded pharmacists, right now, are finding unlimited opportunities for success and recognition at retail prescription counters, in hospital pharmacies, in pharmaceutical production, in analytical and research laboratories—and quite likely they will be successful in several different phases of professional pharmacy.

Pharmacists who have a flair for selling or merchandising are always in demand to fill key positions in independent retail and chain stores and in the sales organizations of wholesalers and manufacturers.

Some pharmacists, after a few years of experience at the prescription counter, return to their alma mater to serve as instructors while completing post graduate study and then become professors, technical consultants, public health service executives, hospital administrators, editors and authors.

My friend and neighbor, Mr. Brown, a vigorous spokesman for pharmaceutical industry has said, "Pharmacy as a profession and an industry occupies a position of increasing importance in the economy

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Billions for Cosmetics

• By Irving N. Ebling and Donald L. Gibson

WESTINGHOUSE ELECTRIC CORPORATION

The Pittsburgh Section of the American Chemical Society sponsors a series of radio talks over Station WCAE.

The talks for 1952-1953 were digested and printed in a booklet, "Chemistry and You." This article is reprinted with permission of the Pittsburgh Section of the American Chemical Society.

The title "Billions for Chemistry" is literally true. Several billion dollars are spent annually in this country on cosmetics, hair waving lotions, perfumes, deodorants and other similar products. This expenditure does not include the cost of allied products, such as machinery and equipment to make and package the cosmetics, nor does it include beauty parlor equipment. The manufacture of cosmetics is a big business and you will find chemistry playing an important role in almost all of its products.

Probably the oldest and still most widely used cosmetic is cold cream. Over the ages it has been more generally applied and has kept its reputation as a skin softener longer than any other preparation. The Roman physician, Galen, is credited with the invention of this wonderful toilet preparation.

Cold cream is an oil-in-water type of emulsion. Lanolin and other oils are emulsified with a compound made from beeswax and borax, or sometimes a triethanolamine soap. The "cold" in cold cream results from the evaporation of water; there is usually about 25% water in cold cream. When applied to the skin the cream takes up a large amount of heat from the skin to evaporate the water. This gives the skin a sensation of being cold. Thus the term "cold cream".

Other creams such as vanishing cream, cleansing cream, all purpose cream, and even brushless shaving cream, are all related to cold cream. They contain various amounts of the oily portion plus other specific additives for special purposes and special types of skin.

A field of cosmetics invaded by the chemist in recent years is the hair-and-scalp-cleaning field. There are several types of hair and scalp cleaners from which to choose: soap types, soapless or detergent types, combinations of the two, dry shampoos, and egg shampoos. The soap, soapless, and combinations are the most popular at the present time.

Soap types are generally vegetable oil soaps containing some coconut oil. Coconut oil gives a copious lather but cannot be used alone since it is irritating to some types of skin. A blend of other vegetable oils with coconut oil will give a soap that is lather-produc-

ing, cleanses well and is non-irritating. Soap types, however, are primarily useful with only soft water. With hard water the curdy precipitates formed with the soap are hard to rinse and tend to dull the natural lustre of the hair.

The new developments in synthetic detergents offer a solution to the hard water problem. Synthetic detergents are excellent materials for hair shampoos. They lather freely, are safe to use and are not affected by hard water. One of the disadvantages of using these new detergent types or soapless shampoos is that they are drying to the scalp. With dry or non-oily hair they remove the natural oils of the skin and tend to leave the scalp in an overly dry condition. With oily hair these shampoos work fine.

Combinations of soap and synthetic detergent represent a large number of the shampoos on the market today. These more closely resemble an all-purpose shampoo since they combine the good properties of both types. They work well in hard or soft water, are non-irritating, and leave the hair feeling soft and silky.

Earlier we mentioned dry shampoos. Many women, because of susceptibility to colds and ill health, use a powder-type dry shampoo. These powder types have a good absorbent material such as starch, clay, or talc as a base and usually borax mixed in with the base to assist in cleaning. Such powders are shaken into the hair and allowed to remain a few minutes. The hair is then brushed thoroughly to remove the powder which has absorbed the grease and dirt off the hair and scalp.

While on the subject of hair and scalp, let us not miss the biggest innovation in hair waving to come on the scene in many a year. The home or cold permanent wave is without doubt the outstanding and most exciting chapter in the cosmetic book. Women no longer have to sit and sizzle under heat that would turn toast into charcoal to get the elusive hair wave.

The cold permanent wave is accomplished by certain safe organic sulphur compounds. These are a class of chemicals known as the substituted mercaptans. By controlling the acidity of the solution these compounds can wave or "reform" the hair. Reforming is the technical term for waving. The cold-waving preparation is truly one of the modern cosmetics that can be entirely attributed to the field of chemistry.

The chemist also plays an important role in the perfume industry. He has not only synthesized many of the naturally occurring perfume compounds, but has created new and lovely smelling substances not found in nature. Also, there are many sweet flowers

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Coordination Compounds, Chelates and General Chemistry

• By Sister Mary Martinette, B.V.M., Ph.D., (University of Illinois)
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The study of coordination compounds can be used to teach many of the basic concepts of chemistry. In addition, the present status of coordination compounds is such that no truly modern course can omit them.

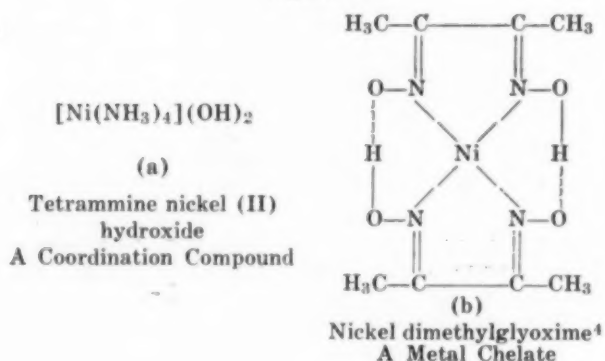
This paper was presented before the chemistry section of the Illinois State Academy of Science, May 4, 1956 in Springfield, Illinois.

To those who are interested in the fundamentals of chelation we recommend the study of this article and Albert Frost's "Fundamentals of Chelation" in the June 1956 issue of the SCIENCE COUNSELOR.

At the very real risk of over-simplification it will be shown in this article that the subject of coordination compounds may advantageously be introduced to the first year college chemistry student.

A generally accepted definition of coordination compounds is: "Compounds in which a metal ion combines with an electron pair donor¹." Such compounds tend to be complex and consequently fall into the somewhat broad classification, "Complex Compounds." The "Lone pair" theory of coordination serves as a useful generalization to help us understand the formation of these complex compounds. The tendency for metal ions to fill their unoccupied orbitals with electron pairs from donor atoms of molecules, or groups, and thereby approach the electronic configuration of an inert gas, was theorized as one reason for complex formation². However, the attainment of this inert gas-like configuration is not the governing consideration. More fundamental thermodynamic and/or steric considerations undoubtedly underlie the problem³. When a donor molecule contains two or more donor atoms ring formation may result. These ring structure coordination compounds are known as metal chelates, as illustrated in Figure I.

Figure I



The donor group is known as a ligand and the number of ligands coordinated to any one metal ion is called the metal's ligancy, (formerly known as its coordination number). The two complex compounds, one a coordination compound and the other a metal chelate, are commonly encountered in the first course in chemistry, especially if qualitative analysis is included. Tetramine nickel (II) hydroxide, $[\text{Ni}(\text{NH}_3)_4](\text{OH})_2$, is suitable for more detailed discussion by the instructor. It illustrates the types of bonds, the generative configuration, and the chemical and physical properties of such relatively simple complex compounds. When different types of chemical bonding in complex compounds are presented, automatically and simultaneously, a representation of the present theory of atomic structure will ensue. A discussion here of the electronic bonding present in tetramine nickel (II) hydroxide serves as an illustration.

The nickel atom of atomic number 28, has been shown by spectroscopists to have an electron configuration of 2, 8, 16, 2. These numbers refer to electrons in lettered, K, L, M, N, or numbered 1, 2, 3, 4, energy or quantum levels at increasing distances from the nucleus, as shown in Figure II.

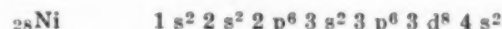
Figure II

nucleus) 2) 8) 16) 2	electron arrangement
	K	L	M	N	lettered energy levels
	1	2	3	4	quantum numbers

The electrons in these quantum levels are arranged in sub-levels designated as *s*, *p*, *d*, and *f*, which may have a maximum number of 2, 6, 10, and 14 electrons respectively. The number of sub-levels increases as the number of quantum levels increases; that is, the first has only an *s* sub-level, the second has only *s* and *p* sub-levels, and so on.

Since the nickel atom has an atomic number, or Z number, of 28, the electron distribution is postulated to be that shown in Figure III:

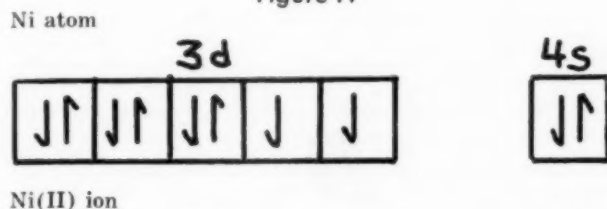
Figure III



The coefficients designate the principal quantum numbers and the exponents indicate the number of electrons in each sub-shell. Physicists have presented data which adequately substantiate this theory. It has long been held that elements with one or two electrons short of, or in excess of, an inert gas-like configuration tend to gain or lose electrons in such a manner as to attain such a configuration⁵. The ground state of the nickel atom, represented by Figure III may ionize to a Ni(II) ion in which the two 4*s* electrons are lost.

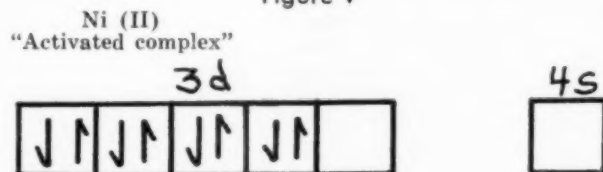
These electronic configurations for the Ni atom and the Ni (II) ion may be schematically represented by the following diagrams, Figure IV.

Figure IV



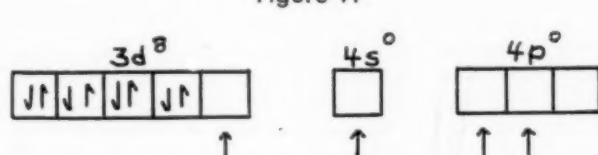
Pairing of electrons within a sub-shell does not occur until each orbital has one electron in it, hence, the two unpaired electrons in the 3d shell of both the Ni atom and the Ni(II) ion. Any further loss of electrons, in addition to the two 4s electrons, would involve the expenditure of a considerable amount of energy in ionizing electrons from the 3d-sub-level. This is given as a reason for the stability of nickel (II) compounds as compared with higher oxidation states. We see that the nickel atom has lost 2 electrons from the 4s sub-level. One of the unpaired electrons in the 3d sub-level is then believed to shift, in the presence of coordinating groups, to pair with the other and leave one empty orbital in the 3d level as shown by the following diagram, Figure V.

Figure V



It can be shown that the coordination (donating and accepting of an electron pair) takes place in one 3d, one 4s, and two 4p orbitals (Figure VI).

Figure VI

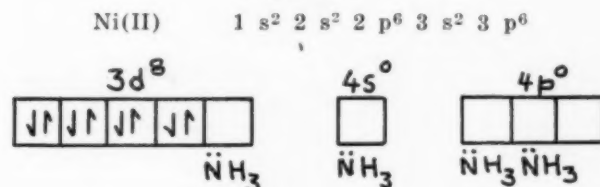


Nickel (II) complexes are said to have dsp^2 bonding. Ni (II) complexes are usually planar in structure, each of the 4 coplanar bonds is directed towards the corners of a square. Most metals in a particular oxidation state have a single ligancy though for a few metals two ligancies are fairly common. Ligancies of four and six are the most common; two and eight are known; twelve has been given, but is questionable.

Since both ionic and covalent bonding are apparent in the compound $[\text{Ni}(\text{NH}_3)_4](\text{OH})_2$, a review of definitions is in order. Ionic bonding, involves electron transfer. Covalent bonding involves electron pair sharing, either by the contribution of one electron by each atom to make the pair shared (covalence), or by the donating of a pair of electrons by one group and the acceptance and subsequent sharing by the other group (coordinate covalence).

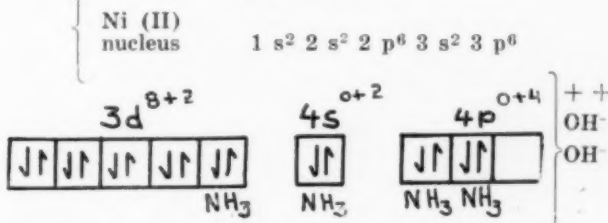
In the $[\text{Ni}(\text{NH}_3)_4]^{++}$ complex ion, NH_3 is the electron pair donor molecule and the nickel (II) ion is the acceptor (Figure VII).

Figure VII



The NH_3 molecule shows an essentially covalent type of bonding, with each H atom sharing its one electron with one unpaired nitrogen electron, giving three shared pairs and one unshared pair of electrons around the nitrogen atom⁶. In relinquishing its two 4s electrons the nickel atom ionizes to give a particle, nickel (II), ionic in character. The acceptance of the two 4e electrons, from nickel, one into each of the outermost energy levels of the two oxygen atoms in the hydroxyl groups imparts a charge to the groups, forming the negative, OH^- , ions. So we have a) ionic bonding, as seen in the nickel (II) ion-hydroxyl ion bond, b) covalent bonding, as seen in the ammonia molecules and c) coordinate covalent bonding, as seen in the complex ion $[\text{Ni}(\text{NH}_3)_4]^{++}$. The four neutral ammonia molecules are said to have no "valence influence" on the nickel (II) ion. A crude illustration, which might be helpful from the teaching standpoint is shown in Figure VIII.

Figure VIII



A great amount of experimental work has been carried out to establish bond types. Magnetic criteria, x-ray analyses, dipole moment studies and other physical measurements all contribute to a determination of structure. A discussion of these is beyond the scope of this elementary explanation though they are used to establish bond type. Magnetic data may be employed to indicate the participation or lack of participation of inner d orbitals in complex formation, if the number of

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Soap Making

• By Sister Mary Charles, O.S.B.

MOUNT ST. SCHOLASTICA, ATCHESON, KANSAS

Choleric caustic, phlegmatic grease, and diplomatic soap are discussed in this whimsical article.

If you are tired of the dry and unimaginative language of chemistry, you will enjoy reading Sister Mary Charles' treatment of soap making.

There is poetry in soap. For soap is satisfied grease, or perhaps better said, soap is satisfied caustic. Soap is formed when a strong lye combines with some kind of fat.

In the world of chemical substances probably the nearest symbol of mental sharpness is potassium or sodium hydroxide. Caustic, it is ever up and doing. It bites and fumes and burns whatever it comes upon. It cleanses but with ruthless force. Why shouldn't it? Lye is the combination of some of nature's most active elements. When sodium is placed on a pan of water it unites with the hydrogen and the oxygen of that usually harmless substance but in flaming fury. Although the hydroxide thus formed is much tamer it still must be handled with great care for it has the properties of consuming fire hidden under the appearance of white crystals or of innocent-looking translucent sticks.

Grease is a kind of soothing force which says, "Things are not so bad. Take it easy. Tomorrow is another day. Come, let me cuddle you to my heart a spell." It offers a welcome to everything that comes along and stays with whatever it rests upon. In every way it seems to be the exact opposite of the choleric caustic. Grease is the picture of passivity. Grease is born when the breath of fire and of animals and the water from the earth are combined by the sunlight and concentrated by living forces in either plants or animals to become stored energy, to give soft contours, to cushion eyeballs, and to ease motion in tight-fitting articulations. Fat serves as a sheath about nerves. If too much fat is missing from nerve cells the subject, which formerly had a feeling of well-being and geniality, becomes irritable and explosive.

In plain words fat is formed when plants or animals convert sugar or starch into a more concentrated form of energy usually for storage. As a rule plants store fats in their seeds. This is a sort of butter for the bread of the baby plant tucked away inside the seed. Sugar is carbon dioxide and water combined by the greenness of plants which uses sunlight instead of electricity to do the cooking. Animals cannot manufacture sugar from raw materials, but they may eat the plants and may use their sugar or starch to release energy in order to keep themselves warm, to make their muscles move, or to store as fat.

Most homemade soaps are made from animal fat. Much commercial soap is made from vegetable oils, coconut, sunflower, olive, palm-nut, and cotton-seed being the most frequently used.

Commercial lye comes indirectly from sea-water for sodium hydroxide is made from common table salt. Potassium is obtained from sea-water also, but being more expensive it is seldom used in homemade soap. Curiously enough potassium lye was used by the pioneer housewife in making a crude but effective soft soap. This lye had a vegetable origin as it was the leachings from wood ashes.

When melted fat or oil is brought into contact with lye a salt known as soap is formed. The action is referred to as saponification. A salt in chemical language is the combination of an acid with an alkali or hydroxide. The lye helps break up the fat into fatty acid and glycerine, and then it combines with the fatty acid, the glycerine remaining unchanged in the mixture.

Thorpe* says that it always takes more lye to satisfy the grease than their combining weights indicate. There might be a parable in that.

We do not know who made the first soap, but it has had a long history. The Roman washerwomen found a place along the banks of the Tiber where the earth had unusual cleansing properties. It was near the temple of Jupiter where the melted fat from the offerings and the ashes from the shrine mingled with the rain forming a rude emulsifier. We have remarked already how resourceful pioneers boiled crude lye with fat to make a soft soap. As the hydroxide became more refined and less expensive, homemade soaps became easier to make until now a very satisfactory white laundry soap may be made at little expense and with little trouble. The ingredients may be as few as a can of lye, two pints of tap water, and six pounds of melted fat.

After the operator has mixed the lye with the cool water he allows it to stand until it is about 80° F. The melted and strained fat is allowed to cool to about 90° to 110° F. The soap-maker then adds the fat to the lye mixture stirring with a slow, even motion as he adds the grease in a steady, thin stream. He continues to stir until the mixture becomes honey-like and heavy. After that for about another half hour he stirs it occasionally. The soap is then allowed to harden and is cut up into bars after about 24 hours. Anyone making soap should read and heed the directions given on the lye-can.

The cleansing power of soap has a quality about it which reminds one of the successful diplomat. It is gentle, even tender, yet it is magical in its results, for

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* Dictionary of Applied Chemistry, Vol. 6, p. 146.

The Ultimate Weapon

ICBM -- Inter-Continental Ballistics Missile

• By Jerome Niedermeler

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Mr. Jerome Niedermeler is a junior in St. Basil's High School, Pittsburgh.

This paper was presented at the spring meeting of the Pennsylvania Junior Academy of Science. It is the product of Mr. Niedermeler's extra-curricular reading and research.

Except for a few minor deletions, this paper has not been edited.

During the last world war, the Third Reich of Germany began a project which, if completed, would have won the war. This was their program for the development of long range guided ballistics missiles, the project which produced the now famous V-2. Since then, the major powers of the world have opened their eyes to the fact that the next war, if it ever comes, may very well be won in a very short time by using guided missiles.

Engineers in all parts of our country, especially in the south and west, are now well on their way to completing designs for primary intermediate range missiles. These missiles though of smaller size and range, are necessary steps which will help greatly and influence design for some time to come.

The over-all dimensions of an ICBM will be: height—85 to 100 feet; maximum diameter—10 to 12 feet; weight—approximately 100 tons. The ICBM will have four main fins, placed at the rear by the exhaust exit, about ten feet high and five feet wide. These will control the flight of the rocket at the beginning of the upward travel out of the atmosphere. There are also four small gas jets on the quadrant marks of the detachable nose cone, which also acts as the warhead carrier. The cone will be made of extra heavy metal and will have special heat radiation-detection equipment.

The entire missile also presents quite a problem, because of the extremely high temperature it encounters during its incredibly fast fall from the height of 600 miles. This height of 600 miles means a fall from the extreme cold of space to a temperature of almost 10,000 degrees Centigrade in less than a minute. There are two ways of preventing the complete disintegration of the missile. The first is to put a complete cooling system around the entire missile and add about 10 tons to the take-off weight, or we could put to use the various heat-resisting metals and alloys which we now have.

Heading the list of alloys are the aluminum alloys and K-monel, a nickel-copper alloy, containing 67%

nickel and 28% copper, the balance being iron, manganese, silicon, and carbon. It is easily forged and has the strength of medium steel. The pure metals are aluminum and titanium steel. These two metals are highly resistant to corrosion and have higher than ordinary melting points. There are also some problems that go along with the selection of the metals. The first is durability. All the above metals are durable enough for the job and could serve admirably. The second is weight. Aluminum, of course, is the lightest, but the alloys are stronger; the monel is not too heavy, and is also rather strong. The titanium steel is the strongest, and is almost at the half-way point between aluminum and monel. This shows us that our logical choice is titanium steel, so far. The third point, and the last to be considered here, is cost. Aluminum is the cheapest, monel is next, then the most expensive, but not by much, is titanium steel, which is still our choice.

This takes care of metals, at least for the time being, for they will come up again when we consider the motor. We will now consider the problems of fuels and oxidizers. The main things here will be the combinations of chemicals and speed of the resulting reactions. If we have two very powerful, but slow-acting fuels, they will have to be dropped from the picture in favor of a faster-acting combination.

Chiefly, we will think in terms of fuels and oxidizers, but there is a distinct possibility of using a solid or semi-solid propellant which carries its own fuel and oxygen. However, these are usually more unstable than liquids, even though they keep a while longer.

When discussing fuel combinations, the liquid oxygen-alcohol combination is often the first to be thought of. This is a fast, powerful reaction, giving carbon dioxide and water as the products of their combustion. This is quite adequate for shorter range flights, but in extreme long range missions the rapid evaporation of these two has to be taken into consideration. Since we need every bit of fuel, this combination is impractical. Perhaps we can use some other oxidizer and fuel which do not evaporate nor decompose as readily, but have as much as, or more, power.

There are many such combinations, but we shall now talk about one such mixture, that of dimethyl hydrazine and nitric acid. Although hydrazine is at the

Reaction of Hydrazine with Nitric Acid

- 1) $N_2 H_4 + HNO_3 \longrightarrow NH_3 + NO + H_2O$
- 2) $4NH_3 + 6NO \longrightarrow 5N_2 + 6H_2O$

moment rather prohibitive in cost, \$5000 per ton, if it is used, the cost will come down very sharply. Besides, it oxidizes very readily and to a great extent, in nitric acid, releasing nitrogen and water. It is also a very fast reaction, almost instantaneous, and is very power-

ful. These are the main liquid propellants we will discuss, although several others such as liquid methane-liquid oxygen, liquid oxygen-liquid acetylene, and the so called—"perfect" combination, liquid oxygen-liquid hydrogen are very good. But many of these do not have the power of hydrazine and nitric acid, while the others are too hard to keep stored and to manufacture.

The only other substance which could be useful as a fuel would be a semi-solid explosive, such as trinitrotoluene, otherwise known as TNT. However, in the semi-solid state TNT has a tendency to explode. It also decomposes rather readily. When exploded, it gives carbon dioxide, carbon monoxide, nitrogen, hydrogen, and carbon. If exploded under pressure, methane gas is also produced.

All things are not so easily worked out as the problem of picking out the correct propellants. There are distinct difficulties that have to be worked out before any of the giant missiles will ever leave the ground. For example, the motor itself presents a goodly number of problems that very definitely need solving.

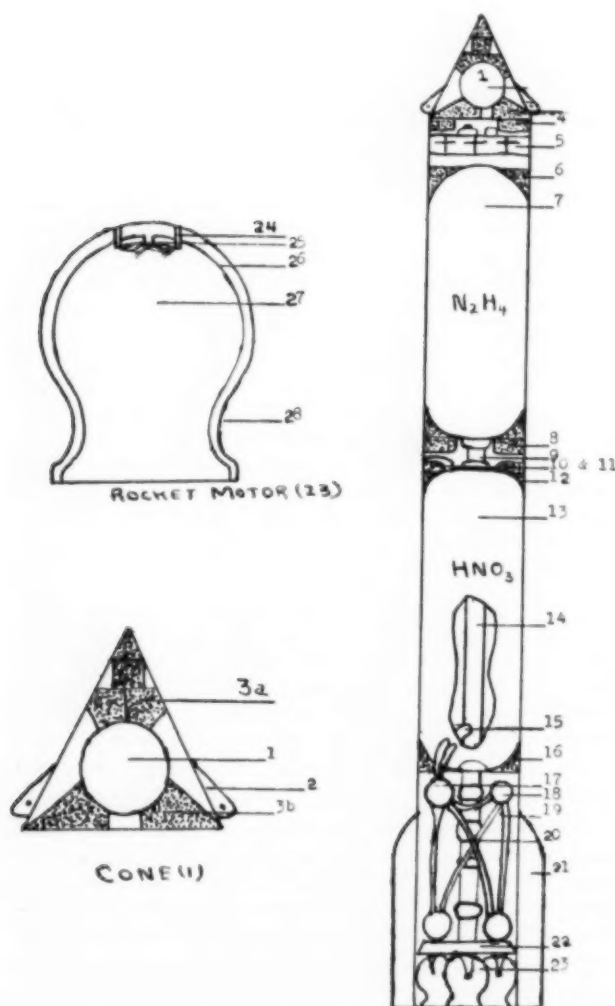
Perhaps the largest problem is the stoppage of melting in the motor without losing strength or making it heavier. One recent step in the right direction has been the development of "cermets" by the metallurgical engineers at Redstone Arsenal in Alabama. Cermets are a combination of highly tempered titanium steel for strength, and a new type of ceramics for expansion. A strange thing about cermets is that although they can take temperatures and pressures almost double that of ordinary metals and alloys, they crack if taken from extreme cold to extreme heat. Because of the change encountered by the outside of the missile, cermets cannot be used for the exterior skin. Nevertheless, cermets solve the melting problems facing the men who will have to design and build the motors.

But even cermets are not infallible, we need some sort of adequate cooling for the motor. This has always been a problem to the missile-men, and has, as yet, not been entirely and to the satisfaction of all, solved. Some experts say to immerse the entire motor in some coolant, and keep circulating the liquid around the motor. Others say to install pipes around the motor and then pump the fuel into the jacket. This latter serves a double purpose, heating the fuel and cooling the motor. The double-purpose type will, in all probability, be used.

Another thing which concerns the experts is the construction of adequate fuel pumps. Most engineers think that centrifugal turbine pumps are the only logical choice, because they are the only kind that can handle the large volume of propellants that will necessarily be handled. The same kind of pumps were used in the V-2 and they gave the German rocketeers quite a bit of trouble, and our pumps will have to be bigger.

Outside of the motor, two very important points show up—range and accuracy. Range is the distance which the missile is able to travel. At present, the

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INTERIOR OF AN ICBM—NUMERICAL INDEX

1. Thermonuclear warhead.
2. Gas jets and fins.
3. Heat detection equipment (a) and electronic computers (b).
4. Analogue translators.
5. Telemetering equipment.
6. Tank support structure.
7. Fuel tank (Hydrazine tank).
8. Fuel tank support structure.
9. Fuel pipe.
10. Fuel regulator and
11. Fuel gauge.
12. Oxidizer support structure.
13. Oxidizer tank (Nitric acid).
14. Concentric fuel pipe.
15. Feed line to fuel pump.
16. Tank support structure.
17. Fuel pump.
18. Helium tank (for initial pressure in fuel pumps).
19. Helium feed line to fuel pumps.
20. Auxiliary force-feed fuel pipe.
21. Main steering fin (4).
22. Rocket motor support stand.
23. Rocket motors (5).
24. Inlet for hydrazine (fuel) in motor.
25. Inlet for nitric acid (oxidizer) in motor.
26. Double wall for cooling motor.
27. Combustion chamber.
28. Chamber constriction or nozzle.

Algebraic Table for Teaching Calibration of Weights

• By **James W. Hackett, O.P., Ph.D.,** (Yale University)

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The student of quantitative analysis must not only learn to use the analytical balance but must have confidence in his ability to weigh correctly. The calibration of weights is an excellent exercise to develop skill and confidence.

The use of Father Hackett's algebraic table is an excellent aid in teaching the basic concepts of calibration.

In teaching students of analytical chemistry the principles underlying the calibration of weights, recourse is usually had to the table of experimental values which is found in most texts of Quantitative Analysis and serves as a practical example of the method¹. The usefulness of such tables as teaching aids is undeniable. However, it has been the experience of the author that a table in the algebraic, rather than the numerical,

form is more helpful in presenting the ideas basic to the calculations of calibration. Precision of expression, clarity, reduction of student-errors, and more efficient use of time have followed from the adoption of unambiguous letters to represent numerical quantities which differ in origin but are frequently identical in value.

The accompanying table is a simplified version of the algebraic table suggested². As in the familiar numerical tables, the first two columns identify (1) the pieces of the set to be calibrated, and (2) the pieces which are used in weighing the former, whose masses have been determined relative to the 10 mg. preliminary standard mass (10₀mg.).

1. Diehl and Smith, "Quantitative Analysis," John Wiley and Sons, Inc., New York, 1952, pg. 60.
Kolthoff and Sandell "Textbook of Quantitative Inorganic Analysis" 3rd ed., The Macmillan Co., New York, 1952, pg. 230, 233.
Willard, Furman, and Bricker "Elements of Quantitative Analysis," 4th ed., D. Van Nostrand Co., Inc., Princeton, 1956, pg. 57, 59.
2. Mass differences rather than mass values for the pieces are used throughout because of the relative ease of handling these smaller quantities in the arithmetic operations of calibration.

Algebraic Table for Calibration of Weights

Unknown Weight Piece W _x	Known Weight Pieces W _k	Measured Mass Difference W _x - W _k	Cumulative Sum of Mass Differences	Aliquot of standard correction factor	Correction Factor for piece (10 g. piece as standard)
10 mg.	10 ₀ mg.	a	A = a	M/1000	A - M/1000
20	10 ₀ + 10	b	B = A + b	M/500	B - M/500
20'	20	c	C = B + c	M/500	C - M/500
50	10 ₀ + 20 + 20'	d	D = B + C + d	M/200	D - M/200
100	10 ₀ + 20 + 20' + 50	e	E = B + C + D + e	M/100	E - M/100
200	10 ₀ + 20 + 20' + 50 + 100	f	F = B + C + D + E + f	M/50	F - M/50
200'	200	g	G = F + g	M/50	G - M/50
500	100, 200, 200'	h	H = E + F + G + h	M/20	H - M/20
1 g.	100, 200, 200', 500	i	I = E + F + G + H + i	M/10	I - M/10
2	100, 200, 200', 500, 1g.	j	J = E + F + G + H + I + j	M/5	J - M/5
2'	2	k	K = J + k	M/5	K - M/5
5	1, 2, 2'	l	L = I + J + K + l	M/2	L - M/2
10	1, 2, 2', 5	m	M = I + J + K + L + m	M	M - M = 0
20	1, 2, 2', 5, 10	n	N = I + J + K + L + M + n	2M	N - 2M
20'	20	p	P = N + p	2M	P - 2M
50	10, 20, 20'	q	Q = M + N + P + q	5M	Q - 5M

Note 1. The symbol 10₀ mg. in column 2 represents the preliminary standard of mass which may be either the rider or an extra 10 mg. piece loaned to the student for use in calibration.

Note 2. Values in columns 3, 4, 5, and 6 are algebraic quantities and may be positive or negative or zero. They are to be determined to the nearest 1/100 mg. When employed in actual weighings, the sum of the correction factors is evened off to the nearest 1/10 mg.

The third column (small letters) gives the measured quantity which represents the difference in the mass between the piece being weighed and the "known" weights. The mechanics of evaluating this quantity will depend upon the method of calibration employed.

In the transposition method, a, b, c, etc., will be equal

to $\frac{R_1 - R_2}{2S}$, where R_1 is the rest point when the piece

being weighed is on the left pan and the weighed

pieces are on the right; R_2 is the rest point when the pieces have been transposed; and S is the sensitivity of the balance under the load. Using the method of substitution, the small letters of the third column

would equal $\frac{R_1 - R_2}{S}$, where R_1 is the rest point when

the known weights on the right pan are balanced against the tare; R_2 is the rest point when the piece being weighed is balanced against the tare; and S is the sensitivity.

The fourth column (capital letters) lists the difference between the determined mass of a piece on the 10 mg. preliminary standard scale of values and the ideal mass or face value of that piece. It shows this quantity to be the cumulative sum of the difference found by weighing the piece against the "known" weights and the differences previously established for each of these pieces from their face values. It is this column which makes explicit the origin of the calculated mass difference between the weighed piece and its face value.

The fifth column represents the proportional part or aliquot of the ideal mass difference for each piece based on the assumption that the 10 g. piece weighs exactly 10.00000 g. If an absolute standard were used to establish the true mass of the 10 g. piece, and if the 10 g. piece were found to differ by the quantity w from 10.00000 g., then the proportional parts would be based on the quantity $M - w$. Thus the aliquot of difference for the 10 g. piece would be $M - w$; for the

5 g. piece it would be $\frac{M - w}{5}$; and for the 2 g. piece,

$$\frac{M - w}{5}, \text{ etc.}$$

The last column gives the correction factor for each piece. This factor is shown to be the deviation of the measured mass difference for that piece in the 10 mg. system from the proportional part of the measured mass difference of the standard piece of reference, the 10 g. piece, in the 10 mg. system. Again, if an absolute standard of mass were used as the final reference, the correction factor would be the deviation of the measured mass difference for that piece from the proportional part of $M - w$. Thus the correction factor for the 10 g. piece would be $M - (M - w)$ or

w ; for the 5 g. piece it would be $L - \frac{M - w}{2}$; and

for the 2 g. piece, $J - \frac{M - w}{5}$.

While an algebraic table has been used for several years by the author in his classes and found to be pedagogically sound, it is not free from abuse. Those students who are constantly looking for formulas which they can apply blindly may find such a table the easy way out of the study necessary to understand calibration. One way to avoid this difficulty is to propose only that part of the algebraic table needed to make the principles of calibration clear, and have the students complete the table for the weight pieces in their sets. ●

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Fordham's Guidance Institute

Nationally prominent leaders will address the THIRD ANNUAL GUIDANCE INSTITUTE OF THE SCHOOL OF EDUCATION, FORDHAM UNIVERSITY. The Institute, which will be under the direction of Dr. James J. Cribbin, Associate Professor of Education, will consider problems involved in TESTING AND COUNSELING IN SCHOOLS.

Featured speakers will include Dr. Anne Anastasi, Professor of Psychology, Fordham University, Dr. Donald E. Super, Professor of Education, Teachers College, Columbia University, Dr. William A. Kelly, Past President of the American Catholic Psychological Association, Dr. Walter J. Coville, Chief Clinical Psychologist, St. Vincent's Hospital, Dr. Walter L. Wilkins, Professor of Psychology, St. Louis University, Dr. Roger T. Lennon, Director, Division of Test Research and Service, World Book Company, Reverend William C. Bier, S. J., Executive Secretary, American Catholic Psychological Association, Dr. Genevieve P. Hunter, Director, Archdiocesan Vocational Service, Dr. Alexander A. Schneiders, Director, Office of Psychological Services, Fordham University, and Reverend Albert F. Grau, S. J., Director, Office of Psychological Services, Georgetown University.

The Institute will meet each school day, July 8-July 19, from 1:30-4:30 p.m. The daily program will include a guest lecturer, followed by a two hour workshop session. Workshop directors will be Reverend Brother Philip Harris, O.S.F., Director of Student Personnel Services, St. Francis College, and Dr. Natalie T. Darcy, Associate Professor of Education, Brooklyn College. Brother Philip is editor of the *Catholic Counselor* and was formerly director of guidance of St. Francis Preparatory School and president of the National Catholic Business Education Association. Dr. Darcy is also a Special Lecturer in Educational Psychology, Fordham University.

For further information and descriptive brochure of the *Institute on Testing and Counseling in Schools*, write Mr. William McAloon, Director of the Summer Session, Fordham University, New York 58, N.Y.

Science Teaching

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One necessary but not sufficient element in judging a science teacher's *quality* is his subject matter preparation in science and professional education. College or university preparation does not always indicate how well the college courses were assimilated, what material was actually included under given course titles, the teacher's personality, philosophy of education, understanding young people, and other traits essential for successful science teaching.

To discuss how well or how poorly some science teachers are prepared could well be an article by itself. But, it is a sad truth that many legally certified science teachers do not teach science. They may even teach other subjects instead of science, or some may be devoting time to educational or athletic administration. There is a real crisis involving the *quality* of our science education.

A Philosophy of Teaching

The science teacher too often teaches as he was taught at the college level. Here the materials of instruction were largely used to show facts and facts only. In the secondary school the teaching of science should strive for definite objectives and principles rather than the basis of college teaching.

The finest philosophy begins with the principle of conduct which is applicable not only to teaching but to all of life. It is well expressed in the adage, "Whatever is worth doing at all is worth doing well." This sounds like a moral maxim but it is in reality only good common sense, because a consciousness of skill, of artistry, of accomplishment in the face of difficulty are essential ingredients for a satisfying life. Even the uninteresting tasks that are a necessary part of the lives of us all can be transformed by the principle.

To the student who says he is not interested in science the fault may not lie entirely with the subject or the teacher but with the feebleness of his own effort. He may be one of those students who comes to class, settles down onto the small of his back and seems to say, "Well here I am now, darn you, learn me."

There are those who teach for their living but do it so indifferently that they derive very little satisfaction from it. Although teaching is not essential to scholarship, scholarship is essential to teaching. How can an indifferent teacher interest students in the subject at hand if he is not sufficiently interested in it himself to ask any hitherto unanswered questions? To ladle out knowledge from a stagnant pool is poor teaching. As Professor Debye stated, "the use of a funnel in the mouth of the student is no way to instill an ability to think."

In surveying the various textbooks on science teaching they mention the same methods and also present the same results of available research regarding this

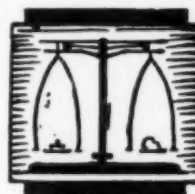
problem. Methodology is well organized into a set of principles that can be of help to the teacher in being effective. In the teaching of science, the teacher should study his problem in the light of objectives and principles sought. Great concern is expressed by industry and our government, both national and state, that natural science is losing ground rapidly. In some of the finest articles published, the writers exhort teachers to show the relationship that exists between science and our democratic form of government.

High schools and colleges throughout the land are adopting a Physical Science Survey course, but it is not meeting the needs of our school population. This item taken from the Harvard Report, *General Education in a Free Society*, summed up tellingly the way in which survey courses are likely to fail: "It is right to let a student know *roughly* where he is going, but wrong to save him the journey."

In an article in *Life*, B. I. Bell, a former college professor and president points out that we are far too reluctant to insist on those formative disciplines which alone can promise proficiency in doing and thinking, and that our schools are seriously crippled by the assumption that the acquiring of the skills and the understanding necessary for effective thinking and honorable living is really quite easy. He also expresses the opinion that the teacher's art should devise ways of imparting to the learners a respect for the basic wisdom of their forbears.

Encouraging Future Scientists

Manpower, a critical, and one of our most valuable resources in every type of society is the most vital cog in our American school system. We believe our American standard of living bears witness to the success of our present and past generations of scientists. Our continuing national prosperity and the safeguard of our nation places more and more responsibility on the teachers, especially the science teachers. The solutions of the scientific manpower shortage is far from simple. This shortage results from a complex situation which has its roots not only in education and training but also in the economic and social fabric of the nation. We do know that the future of our country is directly dependent upon our continuing to train first rate scientists in increasing numbers. What greater challenge can the science teacher accept? It is a duty to tell science teachers that they must face the problem of interesting students in scientific and science teaching careers. It is their duty to face the problem of maintaining and improving the *quality* of science teaching. ●



The Ultimate Weapon

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giant of the guided missiles, the Redstone, has an extreme range of 3,000 miles, but taking air currents and the like into consideration, we can count on an accurate 2,500 miles (meaning accurate to .01%). We need a range of from 5,000 to 12,000 miles. This fantastic range can only be obtained by picking the correct propellants, the best metals, and the best technicians available. Besides range, we need almost pinpoint accuracy.

Many things go into making a missile accurate, among them being telemetering systems, detection equipment, and electronic computers. They all come under one heading: guidance. For our extreme long range flights to be accurate, we must have accuracy to the n th degree. To be exact, an error of .01% can be allowed on a 5,000 mile mission. For a mission of 10,000 miles, we are allowed an error of .001%; on a 12,000 mile flight, the error can be but .0005%. Impossible as it may seem, it is possible to have such accuracy, though it is extremely hard to obtain. Our present telemetering systems can send and receive messages at a distance of ten thousand miles by bouncing the waves off the blanket of the ionosphere. It is entirely within the range of reason that this can be increased to the maximum of 12,000 miles.

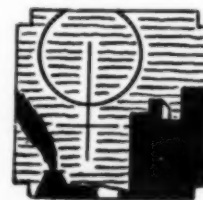
Now that we have solved the problem of communication with the missile, we must have a way of getting the missile to respond to our commands. This is where we get into the field of fabulous electronic brains, which will take our information and translate it into a language which the missile can understand. If our rocket were to stray off course, the computer will have to select a corrective tape from its stored information, and translate it so that the controls of the missile respond correctly and get it back on course. To emphasize the importance of being on course, let me say that even with thermo-nuclear warheads the target cannot be missed by more than one-half of a mile, and that is stretching it to the greatest effect of such a bomb.

ICBM's will very definitely speed up war, as they will cut the time it takes to deliver the conclusive blow to from one to two hours. This means that if war would break out in Europe or Asia, the United States could end the conflict with a shower of H-bombs in a matter of hours or even minutes. Besides the speed up, this type of war will mean more destruction and devastation, spread over a smaller area.

As for a defense against ICBM's, it is not impossible, as most military men often say. If we were to use a conventional missile, say a Nike, we would have little chance of stopping any large rocket offensive. But if we use specially-built, finless, guided interceptor rockets, with an extremely fast interception speed, our chances increase to that of the fond expectation of pitching pins from opposite ends of a great hall and

expecting them to collide in mid-air. If we launch ten of these for every missile sighted, we then have a feasible chance.

These missiles in the hands of an aggressor nation, can lead to world domination, but in the hands of peace loving nations they can be a very convincing deterrent. Inter-continental ballistics missiles are going to have a very definite effect on the shape of things to come. It all depends on who has them as to what the effect will be. They can cause the world and all the life on it to cease to exist, or it can help in one of the most important steps man will ever take—the step into space. People in future generations may scoff at our uncivilized custom of trying to kill off the excess population with gigantic missiles of destruction; but our first stumbling steps will lead to the proud, sure steps of a successful, grown-up world. We should all pray to God that we get them first. ●



Careers in Pharmacy

(Continued from Page 50)

of the nation. Services in the interest of public health, contributed by the medicinal products produced through enterprise in the pharmaceutical industry in research and production, guarantee the respect and appreciation of the average citizen¹.

The rapidly growing pharmaceutical industry has created an increasing need for professional personnel in research, production, product control, sales, advertising and administrative positions. There are indeed few professions which can surpass pharmacy in expanding opportunities, diversity of interest and possibilities for advancement.

Those who are considering careers in pharmacy should keep in mind that if they believe deeply in their future, then they cannot fail to earn what is needed of the material things of life; and, what is more important, satisfaction and recognition of their services as professional people. From devotion to service in the interest of public health and welfare will also come the hidden gift of accomplishment. ●

REFERENCES

1. Medical Marketing, November 1956—A Medical Economics Publication.
2. "The Shortage of Scientists and Engineers"—Business Week, November 10, 1956—A McGraw-Hill Publication.
3. "Shall I Study Pharmacy?" Available upon request to the Secretary, American Association of Colleges of Pharmacy, College of Pharmacy, University of Illinois, 833 South Wood Street, Chicago 12, Illinois.
4. "The Pharmaceutical Industry" by Francis C. Brown, President of Schering Corporation, Bloomfield, N. J.

Billions for Cosmetics

(Continued from Page 51)

with desirable odors that do not yield an essential oil. In these cases the chemist has formulated successful substitutes.

Perfumes and essences were in use even before earliest records of history. From the Bible or books such as "Arabian Nights" we know that a few grains of frankincense or a few drops of perfumed oil were regarded as gifts worthy of a king or a god. Even today we are willing to pay high prices for the satisfaction of the senses of smell and taste. When one buys natural violet perfume he is paying at the rate of more than \$10,000 a pound for the essential oil it contains, the rest is mere water and alcohol.

Perfume is not only an essential oil or mixture of oils. One of the most important ingredients of a perfume is a substance that is added, not for its odor value, but for its ability to prevent the rapid evaporation of the more volatile and fragrant essential oils. Since such substances function by fixing the odor they are termed fixatives. They are generally of three varieties or classes—animal, vegetable and synthetic. The perfume materials from animals are ambergris from the whale, civet from the civet cat, and musk from the musk deer. The vegetable fixatives are balsams, gums and oleoresins. The chemist has also formulated synthetic fixatives such as coumarin, vanillin, artificial musk and a host of others. To summarize, a perfume would consist of a fixative together with one or more essential oils.

However, it should be emphasized that a fine brand of perfume may be compounded with a dozen or more different ingredients to produce the desirable single harmonious effect on the sense of smell. Perfumery is one of the fine arts. The perfumer, like the orchestra leader, must know how to combine and coordinate his instruments to produce the desired sensation. For instance, a Wagnerian opera requires 103 musicians; a Strauss opera requires 112. If the concert manager wants to economize he will insist upon cutting down on the most expensive musicians and dropping out some of the others, say, the man who blows a single blast or tinkles a triangle. Only the trained ear will detect the difference. The same principle can be applied to the formulation of perfumes. The perfumer can go about it in the same way. For example, he analyzes oil of roses which costs \$400 per pound and finds that the chief ingredient is geraniol which costs \$5.00, the next is citronellol worth about \$20.00, then come others in the same price range. So he makes up a cheap brand of perfumery out of three or four such compounds. But the genuine oil of roses, like other natural essences contains a dozen or more constituents and to leave many of them out is like reducing an orchestra to a few loud sounding instruments or a painting to a three color print.

But other cosmetics are equally as important as perfumes. From the number of times a woman pow-

ders her face each day, you would guess that the average woman must use at least ten to fifteen pounds of face powder each year. Yet a careful check shows that the average American woman uses less than one-tenth of a pound.

The use of face powder transforms skin with a disagreeable shine into a soft and velvety loveliness. The use of face powder satisfies at least three of the senses—the skin looks good, smells good and feels good.

A combination of many materials goes into face powder to give it these desirable characteristics. The main ingredient is ordinary talc. Talc gives it the proper slip so that it is easy to spread. It also gives it a nice smooth feel. Zinc oxide, or sometimes titanium dioxide, is used in powders to give the proper covering power. For smooth adherence zinc stearate is used; this compound causes the powder to cling to the skin. To incorporate the colors and perfumes it is necessary to use an absorptive material such as chalk.

This article touches only the highlights of chemistry in the field of cosmetics. Chemical research certainly has played, and will continue to play an ever increasing role in the billion dollar cosmetics industry. ●

★ ★ ★ ★ ★

Soap Making

(Continued from Page 54)

the soap embodies in itself the cleansing power of the caustic and the soothing force of the grease. By a film of foam the soap tactfully surrounds the foreign particles adhering to an object, and with a firm, yet delightful persuasion loosens the hold by which it clings. Then the clean water sweeps both away, and the once-soiled object begins to reflect its inner beauty.

Somewhere I once saw a round-eyed child bending over a tub of wash water. As her baby hand slapped the gray gloom it suddenly became transformed. White foam danced on the surface. Gay bubbles winked at her and disappeared. Rainbow colors, pink, blue, and coral glanced up from the myriad "eyes." Her mother, deeply touched by what she saw and heard and knew, wordlessly mixed clean suds in a cup of warm water. Then she showed her little daughter how to set the bubbles flying from the end of a hollow pipe.

Poetry in soap? Yes: the poetry of the sea, the sky, the earth, of growing plants, of hungry animals, of man's first groping after God, of a pioneer mother's determination, and of a child's laughter.

Soap is the poetry of the conversion of a substance which, by its nature nourishes, soothes, and cherishes indiscriminately anything coming to itself by a substance which is all fire, fury, and destruction. Because gentle grease has harbored the fierce lye it becomes a new substance which can firmly banish the stains and smears of everyday living and give useful but soiled things another chance to begin again in clean beauty. ●

Anthropology

(Continued from Page 49)

arbitrary academic or pedagogic division. One will find a great deal of psychology and history in anthropology. There will be political science, economics and sociology. The humanities will not be overlooked, for there will be art and aesthetics, religion, folklore and mythology. Of the social sciences, anthropology concerns itself to the greatest degree to the complete human being. It seeks to understand the entire realm of human behavior conceptualized as a culture and the place and roles of the individuals that make up a cultural unit. It concerns itself with particular areas of human action only to the extent that such knowledge will assist in the completion of the whole picture.

Relationship to Sociology

There are many who wonder about the relationship of sociology to anthropology. The curiosity could be extended to the relationship of both sociology and anthropology to the other social sciences. It would be impossible to give a precise answer. The specialization, the fragmentation, or the divisions within the social

sciences came about in no particular planned way. The efforts of the social scientists to identify themselves at least with the methods of the natural scientists has made for a great deal of internecine strife and confusion. Professor Redfield says that the social scientist's emphasis on this formal method of the natural sciences "sometimes carries the social scientist into exercises in which something not very important is done very well." This attempted emulation of the natural sciences has led to a considerable amount of division among the social scientists and an almost complete detachment from the humanities. Yet, in reality, the social sciences and the humanities are all concerned with the same subject matter—man, humanity, man's activities. There are those who say that social anthropology and ethnology are one and the same thing. This is followed by the statement from another source that sociology and social anthropology are one and the same. It would therefore follow that sociology and ethnology (and therefore anthropology) are one and the same. It would be much easier for the student to recognize social anthropology as a subsection of cultural anthropology and having its interest in social behavior *per se*, with only incidental interest in many other aspects of culture, such, for example, the technical aspect. Accepting this, we could recognize the close relationship or even identity of social anthropology to sociology. We go on a little further and find that psychology and social anthropology and sociology meet on a common ground and are indistinguishable in the field of social psychology.

Further analysis both of the subject matter and of the innumerable textbooks will give us little help in distinguishing any significant difference between sociology and anthropology. Currently, sociology is using anthropological jargon, and contrariwise, anthropology is using sociological terminology. The alleged difference that anthropology deals with primitives and sociology with moderns is of no value, for in neither case do these studies so confine themselves. About the only thing we might safely say about the differences between these two studies, sociology and anthropology, is that of parentage. They have different parentage. Anthropology had its origin in the natural sciences and still has a great deal of the natural science tradition, respect and acceptance. Sociology, like psychology, arose primarily out of philosophy and for many years was indistinguishable from social philosophy or political economy. Anthropology appears to have grown out of the natural science orientation and becomes, more and more interpretative and speculative; on the other hand, sociology goes the opposite direction and is trying desperately to identify itself with the natural sciences. Perhaps future academicians will bring us back more in conformity with the reality of what we are trying to study, and then we will have just one big package, called either the social sciences or the humanities or even something else, but at least recognizing the unity and the intimate interrelationships of the various studies. The student then will get not a series of very little and apparently disconnected pictures but rather a well conceived mosaic of the reality and unity of man and his works. ●


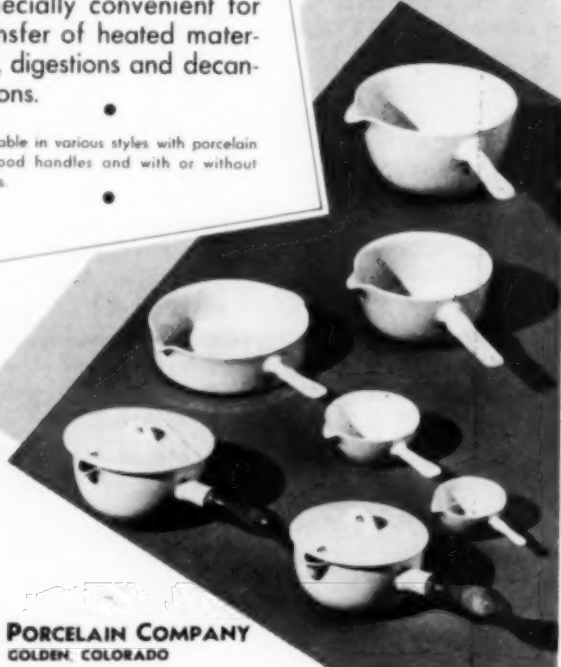
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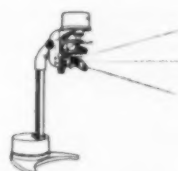
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Coordination Compounds

(Continued from Page 53)

unpaired electrons in the two types of complexes is different. Classification of complexes as "outer-orbital or inner-orbital" types has been made on this basis^{7, 8}.

With this presentation the student has been introduced to the subject of coordination compounds, has had a quick review of atomic structure and bonding—as the chemist envisions it—and has had complex ion formation and structure explained.

An appreciation of the importance of compounds of this nature might well be introduced here and a few well-chosen examples given to illustrate their ubiquity. In addition to their usefulness in analysis, both inorganic and organic, complex compounds have been shown to occur widely in nature. Photosynthesis and cellular respiration, two fundamental biological processes, appear to depend on the ability of a metal to coordinate with a general class of electron pair donor pyrrolic type compounds. These complex compounds are iron porphyrins or heme compounds and magnesium porphyrins or chlorophyll.

The naturally occurring chelates in biological systems have functions which are vital to the organism. Examples of their functions are: catalysis of oxidation-

reduction reactions, oxygen-carrying power, hydrolysis of proteins, decarboxylation and CO_2 -carrying power⁹. Copper is present in a porphyrin complex in some yeasts. A copper uroporphyrin is found in the flight feathers of African *Genus Turacus*! Some of the pigment excreted into the medium by diphtheria bacilli is believed to be a zinc porphyrin. Oxygenated coordination compounds, particularly those which are "oxygen balanced" have value as explosives. Metal ammine nitrates for example, $[\text{Cr}(\text{NH}_3)_6](\text{NO}_3)_3$, have been incorporated in explosive compositions containing ammonium nitrate as the principal ingredient¹⁰.

The treatment of certain plants with chelating agents has produced results not unlike those observed after hormone treatment¹¹. The suggestion has been made that possibly the chelating agent makes certain metal ions in the soil more readily assimilable. Development of both inorganic and organic sequestering agents by the textile industry is still another example of the versatility of these compounds.

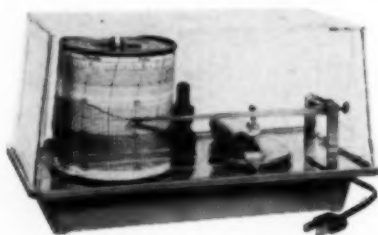
Even vitamins are found among the complex molecules discussed here. One of the most recent reports is that of the structure of the anti-pernicious-anemia factor, vitamin B_{12} . The compound was earlier shown to have the empirical formula, $\text{C}_{63}\text{H}_{90}\text{O}_{14}\text{N}_{14}\text{PCo}$, and for some time it was suspected of being one in which the cobalt ion was bonded by coordinate covalent linkages. As a result of recent investigations, both in this country and abroad, Johnson and Todd¹² propose a formula which shows trivalent cobalt connected in the molecule by coordinate covalent bonding.

The present-day status of coordination compounds, simple and chelate, is such that it would seem unwise to rule them out of an elementary chemistry course. In May, 1955, over nine hundred chelating specialists gathered in New York City at Brooklyn Polytechnic Institute to spend two days discussing the behavior of these interesting compounds. Since the introduction of coordination compounds provides an opportunity to re-present fundamental chemical theory there is added incentive to include them in the general chemistry syllabus. ●

BIBLIOGRAPHY

1. Martell, A. E. and Calvin, Melvin, "Chemistry of the Metal Chelate Compounds," p. 1, Prentice-Hall, Inc. (1952).
2. Emeleus, H. J. and Anderson, J. S., "Modern Aspects of Inorganic Chemistry," p. 172, D. Van Nostrand Co., Inc., N. Y. (1952).
3. Martell, A. E. and Calvin, Melvin, *ibid.* p. 7 and 9.
4. Brody and Murs, J. Chem. Soc., 1930, 1599.
5. Emeleus, H. J. and Anderson, J. S., *ibid.* p. 10.
6. Pauling, Linus, "The Nature of the Chemical Bond," 2nd ed., p. 72, Cornell Univ. Press, N. Y. (1940).
7. Martell, A. E. and Calvin, Melvin, *ibid.* p. 213.
8. Taube, H., Chem. Rev., 50, 80 (1952).
9. Martell, A. E. and Calvin, Melvin, *ibid.* p. 499.
10. Tomlinson, W. R., Ottoson, K. G. and Audrieth, L. F., J. Am. Chem. Soc., 71, 375 (1949).
11. Chem. and Eng. News, 33, 2070 (1955).
12. Johnson, A. W. and Todd, Sir Alexander, "Vitamin B_{12} ", Endeavour, XV, 29-33 (1956).

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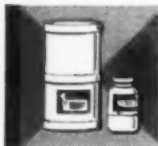
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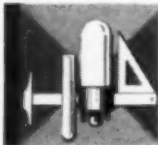
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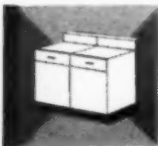
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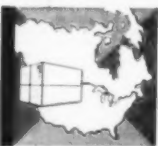
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The Bell Solar Battery

(Continued from Page 46)

pleted last year by the Bell System at Americus, Georgia where the Bell Solar Battery for the first time furnished electricity to power telephone calls over a rural telephone system. Furthermore, the solar batteries used in this experiment not only supplied sufficient electrical energy to provide telephone service during the day when the sun was shining but they also provided sufficient energy so that part of it could be stored away in nickel-cadmium batteries to keep the service in operation during the night and on days when the sun's rays were ineffective. Tests indicated that when the solar battery is exposed to the sun for twelve hours, sufficient energy is stored to operate these telephone circuits for eight days.

While the results of Americus, Georgia experiment were most favorable, what is of far greater significance is the tremendous potential which the basic principles underlying the operation of the Bell Solar Battery offer for the future. For the scientists who discovered those principles now know that silicon, one of the world's most common elements, can now be so processed as to make possible the creation of a whole new series of devices capable of major contributions to human progress.

One of these devices is the so-called silicon junction—using the principle of the pn junction.

Making telephone connections requires a large number of switches. For example, on a call within the same area as many as a thousand switches must operate to put the call through to its destination and several times that many are needed to put through a call to a distant point. In fact, in each of the thousands of the larger telephone central offices, there are as many as 50,000 or more separate switches waiting and ready to handle telephone calls.

Today, mechanical switches are used in these offices. They are somewhat delicate, large and require considerable care and power to make them operate efficiently. By contrast, a tiny silicon junction—the size of a pinhead—will not only do the same job equally well but it will do it faster, with less maintenance and also with less power.

What the future potential of these silicon devices and the Bell Solar Battery itself may be, of course, only time will tell. That it has a future bright with promise, however, is already quite evident—and all because three scientists at the Bell Telephone Laboratories found a way of combining three common elements, silicon, boron and arsenic, in such proportions that when exposed to light would produce an electric current.

Now other Bell System men and women are taking that principle and converting it into a new technology which in the not too distant future will help to speed a nation's telephone calls on their way.

That, in the final analysis, is the real significance of the Bell Solar Battery. Like the countless other improvements that have come into the telephone business in the more than three-quarters of a century that has gone by since Alexander Graham Bell first invented the telephone, it is one more milestone in the continuing efforts of the Bell System to make telephone service better today than it was yesterday and still better tomorrow. ●

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Nitrogen

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The twentieth century drama of ammonia is primarily the story of synthetic ammonia, for it provides our main source of the vital element, nitrogen. The future food supplies of our fast-growing population, an anticipated 200 million by 1970, depend to a great extent on adequate supplies of nitrogen. Our national defense depends on nitrogen, essential component of explosives. This chemical building block serves the very fabric of our economy in a wide variety of ways.

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Nitrogen is essential to all life, both plant and animal. In elemental inert form, it makes up 80 percent of our atmosphere. Nature captures nitrogen from the air in lightning. Electricity forces the gas to combine with oxygen in the air making oxides. With rain they form a weak nitric acid. In this way, 50,000 tons of nitrogen come to the earth every day in rain. Also, in cooperation with legumes, certain soil bacteria fix air nitrogen. But this amount is not nearly enough to meet our food needs. Chemically combined or fixed nitrogen must be produced synthetically to satisfy this demand.

The discovery of nitrogen is usually credited to Dr. Daniel Rutherford of Edinburgh, in 1772—uncle and physician of Sir Walter Scott. The name nitrogen was derived from its constituent, nitre or salt-peter.

In the 1840's Justus Von Liebig announced that nitrogen is one of three basic plant nutrients and Christian F. Schoenbein accidentally discovered that nitric acid and sulfuric acid applied to cotton produced "guncotton." The development of nitrates of cellulose opened the way to other uses of cellulose not only from cotton but also from wood pulp. Examples are the first plastic, celluloid, made by John Wesley Hyatt in 1868; lacquers for which another American, John Henry Stevens, discovered an effective solvent in 1882; and rayon in 1884. In 1888 came the cyanide process for extracting gold and silver from low grade ores. The next year Alfred Nobel developed a more controllable and so more widely useful explosive—dynamite.

Need Outstripped Supply

The need for nitrogen compounds grew and grew. The world's main source was Chilean nitrates. Then, in 1898, Sir Walter Crookes warned that the supply would not be sufficient to meet world needs.

In the atmosphere was a limitless supply of nitrogen. The problem: how to get it out in usable quantities? A method for fixing atmospheric nitrogen, the Frank-Caro process was developed in Germany. In this process nitrogen from the air is combined with calcium carbide at 2000° F. to make calcium cyanide, rich source of nitrogen fertilizer. The process was improved and put into successful operation at Niagara Falls, Ontario, in 1909.

Meanwhile, growth of the iron and steel industry brought by-product coke oven production of ammonium sulfate fertilizer.

The great break-through in nitrogen fixation came in Germany just before World War I. Fritz Haber succeeded in developing a catalytic process for combining atmospheric nitrogen with hydrogen gas under high pressure to form synthetic ammonia. The first German plant started up in 1913. This new source of nitrogen for munitions made Germany independent of Chilean sources of nitrates.

The first U. S. synthetic ammonia plant, using a modification of the Haber process, was built in Syracuse, New York, in 1921. By the end of 1957 there will be 54 anhydrous ammonia plants in 28 states operated by 40 different companies.

The complex equipment required to synthesize ammonia is costly. Its production depends on economic sources of hydrogen. Synthesized as a gas—82 percent nitrogen—it is liquefied under pressure for shipping. Much of it is converted on the spot to nitric acid.

In 1956 the United States produced 3.3 million tons of anhydrous ammonia. About three-fourths of it went into fertilizers. From 1946 to 1956 consumption of nitrogen in fertilizers increased 260 percent.

The young lady applying ammonia to the front lawn is not literally applying ammonia but a nitrogen compound made from ammonia, probably combined in a balanced mixed fertilizer which also contains the other two basic plant nutrients, phosphorus and potash. Whether a dry mix or a water solution, the nitrogen in it helps make grass green and healthy.

A relatively new use of ammonia is for direct application to soil as a gas. The equipment to handle the gas under pressure was developed in the 1940s. The gas is needed into the soil where it diffuses in all directions. This revolution in fertilizing practice enables farmers to plant a pay crop every year without depleting their land.

Explosives Important Use

The next largest use of synthetic ammonia is to provide the nitrogen content for explosives. Important as they are to our national defense, explosives have crucial peacetime uses too. They make it easier to extract metals from the earth, to build tunnels through mountains, and to drain swamplands. Without them, construction of the Lincoln Tunnel in New York might have taken hundreds of years. The dam going up on the Columbia River, strip mining in the west, and the new road construction program all require them. Well over 100,000 tons of nitrogen a year go into nitric acid for industrial explosives which today far exceed military explosives in amount produced.

Ammonia and the nitrogen compounds derived from it have about 2,000 industrial uses in all. In 1954, plastic materials, synthetic resins and lacquers took more than 60,000 tons of nitrogen for their manufacture. Textiles took almost that amount. Other important industrial uses include ore processing, metal treating, paper pulping, petroleum processing, and refrigeration.

Ever since the first organic chemical, urea, was synthesized by Friederich Wohler in 1828, nitrogen has played an important role in synthetic organic chemical production. Urea as it is produced and used today is a good example. As a fertilizer, it provides a high nitrogen content. A modified form of urea marketed recently releases its nitrogen gradually throughout the growing season. As a resin, urea goes into plywood adhesives, plastics, paper and textile treating, and paint. Third major use of urea is as a source of protein food supplement for cattle and sheep.

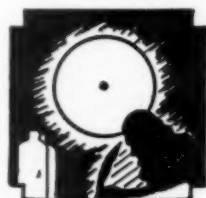
Another organic nitrogen compound making news these days is acrylonitrile. Introduced on the industrial scene in 1940, it had its first use in World War II production of synthetic rubber. By 1955, production

was over 100 million pounds. Acrylonitrile is the key chemical in the production of acrylic fibers, whose many merits in clothing and home furnishings are now well-known. The same properties that turn acrylonitrile into a valuable fiber explain its use in plastics and synthetic rubber where it adds strength and oil resistance.

Each year the chemical industry introduces new nitrogen compounds and new uses for existing compounds.

So, as demand for products requiring nitrogen climbs sharply upward and as our population increases in relation to our farm acreage, we can look with confidence to the tall towers of the synthetic ammonia plants on the American horizon. Nowhere in man's harnessing of the elements to serve man's needs better exemplified than in the chemical industry's production of fixed nitrogen.

—Chemical News



Biochemical Individuality

That no two people are alike, an ancient and intuitive axiom, is recognized today as a scientific truth. Those modern discoveries that bring human variations into the limelight, and their beneficial implications for medicine, biology and psychology, form the basis of the new book, *Biochemical Individuality*. Written by Roger J. Williams, the volume was published in December by John Wiley & Sons.

Dr. Williams advances his genetotrophic concept, the simple principle that every individual organism with a distinctive genetic background has equally distinctive nutritional needs which must be met for optimal well-being. It is evident, for example, that some stomachs hold six to eight times as much as others with eating "habits" varying accordingly, or that some people live to a ripe old age relatively free from illness although from a nutritional point of view, they would be considered sub-standard. In a series of 182 normal young men, it was found that the heart rates ranged from 45 to 105 beats per minute. Air sickness will prostrate some fliers and be unheard of among others. And are there not some who prefer apple pie to huckleberry, and the other way around?

Biochemical Individuality contains 214 pages and is priced at \$5.75.

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Science Faculty and Senior Postdoctoral Awards Announced by Foundation

The National Science Foundation announced today award of 100 Science Faculty Fellowships in the sciences for the academic year 1957-1958. Awarded this year for the first time, these fellowships are offered as a means of improving the teaching of science, mathematics and engineering in American colleges and universities. Primary purpose of the awards is to provide an opportunity for college and university science teachers to enhance their effectiveness as teachers.

The Foundation also announced, as well, award of 30 Senior Postdoctoral Fellowships in the sciences for the academic year 1957-58, selected from 168 applicants.

Science Faculty Fellows were selected from 416 applicants from all parts of the continental United States and its territories on the basis of ability as indicated in letters of recommendation, academic and professional records, and other evidence of attainment and promise. Applications were reviewed by a panel of scientists, especially competent to make judgments as to the demonstrated and potential ability of the applicant as a teacher of science, under arrangements made by the Association of American Colleges.

Eligibility requirements included a baccalaureate degree or its equivalent, demonstrated ability and special aptitude for science teaching and advanced training, and three years of full-time science teaching at the college level.

Senior Postdoctoral Fellowships were awarded to scientists of demonstrated ability and special aptitude for productive scholarship in the sciences. Sixteen awards were made in the life sciences, and 14 in the physical sciences including a number in interdisciplinary fields. Applications were reviewed by a panel of scientists under arrangements made by the National Research Council.

Science Faculty and Senior Postdoctoral Fellowships carry stipends adjusted to approximate the regular salaries of award recipients. These stipends may be applied toward study or research in an accredited nonprofit institution of higher learning in the United States or abroad.

All awards were approved by the National Science Board upon the recommendation of Dr. Alan T. Waterman, Director of the Foundation.

The National Science Foundation expects to announce a second award period for the Senior Postdoctoral Program and for the Science Faculty Program in June 1957.

Modern Physics

(Continued from Page 44)

Ney, Edward P. "Heavy Elements from Space," *Sc.A.*, May 1951, p. 27.

Rossi, Bruno. "Where do Cosmic Rays Come From?" *Sc.A.*, Sept. 1953, p. 64.

Relativity

Bohr, Niels. "Albert Einstein," *Sc.A.*, June 1955, p. 68.

Hoffman, B. "The Influence of Albert Einstein," *Sc.A.*, March 1949, p. 52.

Whittaker, Sir Edward. "Fitzgerald," *Sc.A.*, Nov. 1953, p. 93.

Low Temperature Physics

Davis, Harry. "Low Temperature Physics," June 1949, p. 30.

Fusion

Ridenour, Louis. "The Hydrogen Bomb," *Sc.A.*, Mar. 1950, p. 11.

Bacher, Robert. "The Hydrogen Bomb, III," *Sc.A.*, May 1950, p. 11.

Bethe, Hans. "The Hydrogen Bomb, II," *Sc.A.*, April 1950, p. 18.

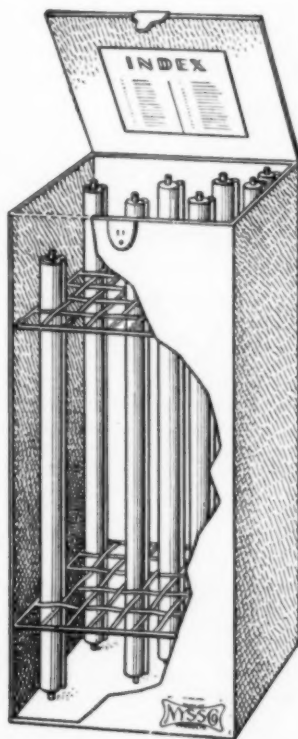
Lapp, Ralph. "The Hydrogen Bomb, IV," *Sc.A.*, June 1950, p. 11.

High Vacuum Techniques

Morrison, Philip and Emily. "High Vacuum," *Sc.A.*, May 1950, p. 20. ●

REFERENCES

1. Jauncey, G.E.M., *Modern Physics*, D. Van Nostrand, Inc., New York, 1948.
2. Hull, Gordon F. *Elementary Modern Physics*, Macmillan, New York, 1949.
3. *Science Reasoning and Understanding*, Intercollegiate Committee on the Evaluation of Science Objectives of the Cooperative Study of Evaluation in General Education. Wm. C. Browne, Dubuque, 1953.
4. Perlman, I. and Seaborg, G. T., "The Synthetic Elements," *Scientific American*, April, 1950, p. 38.
5. Hull, *op. cit.*, VII.
6. *The Autobiography of Robert A. Millikan*. Prentice-Hall, New York, 1950; p. 50, "My Oil-Drop Venture."
7. Darrow, Karl K., "The Quantum Theory," *Scientific American*, Mar., 1952, p. 47.
8. Conant, James B., *On Understanding Science*, Yale University Press, New Haven, 1947, p. 98.
9. "A One-Semester Physics Course for Liberal Arts Students," R. A. Peck, Jr. and W. E. Hartley, Jr., *American Journal of Physics*, October, 1955, p. 440.



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New Books

Early Electrical Machines

- *By* BERN DIBNER. Norwalk, Conn. Burndy Library, Inc. Pp. 58. \$1.50.

The startling advances made in electrical and electronic knowledge during the past century have to some extent obscured the long period of basic experiment and development upon which the achievements are based.

Wide acquaintance is had, of course, with some early experiments, particularly such as those of Benjamin Franklin. It is not so widely known that Franklin's work was based upon an advanced knowledge of data disclosed by many scientists from observations made during many previous decades.

In the book under review, Mr. Dibner has performed a labor of deep interest in researching, illustrating, and describing a wide range of these and earlier experiments and observations over the general period from 1600 to 1800. Much of the information included is in greater detail than in the usual textbooks, and illustrates the long road covered to achieve the present scope of electrical knowledge. Footnotes and reference sources further aid the reader.

The information is well presented, the illustrations are excellent, and the descriptions are clear. This little book, published by a library devoted to electrical his-

tory, should be a welcome addition to the bookshelf of anyone deeply interested in the electrical arts, supplying as it does much information on the ancestry of many of today's electrical machines.

*William H. Carney
Fairfield, Conn.*

The Ornithologists' Guide

- *By* MAJOR-GENERAL H. P. W. HUTSON, Editor. New York: The Philosophical Library, Inc. 1956.

"The Ornithologists' Guide" is excellent and authoritative. Seldom in our long experience of reading all sorts of reference books and texts on the subject of birds, have we encountered such a work as this with so many prominent and genuinely scientific experts assisting in the compilation of valuable papers on every conceivable facet of ornithology.

It was interesting also to realize the vast interest that British people have, not only in bird watching, but in every aspect of bird life. There is no question that the Editors have accomplished their essential purpose, namely, to have this volume appeal to both beginner and advanced student.

Although the contributing scientists represent a wide assortment of geographical areas around the world, there is nevertheless a strong appeal in this book for the bird lover in the United States and in the Western Hemisphere. It is essentially good, however, for bird lovers in this country to have some exposure to the somewhat higher degree of appreciation of birds in other parts of the world, and "The Ornithologists' Guide" definitely has the widest possible appeal of any resource work we have come across in a long while.

We might disagree with a few points such as the opinion of one of the contributors that birds migrate on an empty stomach, but on the whole, it is a well-written, interesting and unusually complete guide.

*John Q. Adams
Montclair, N. J.*

Boy's Book of Frogs, Toads and Salamanders

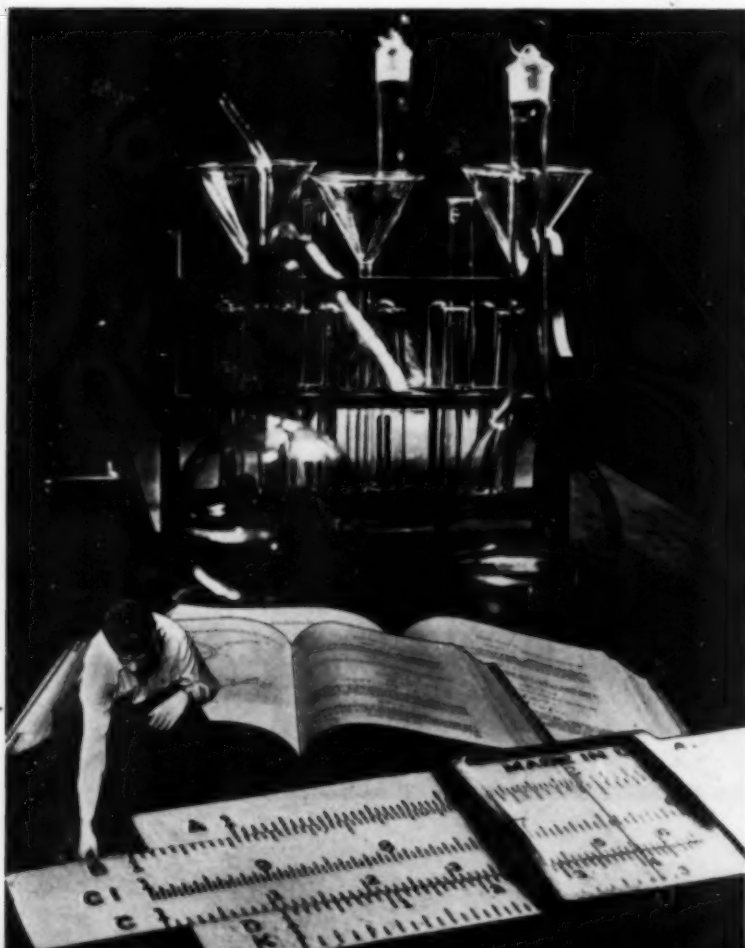
- *By* PERCY A. MORRIS. New York: The Ronald Press Company. 1957. Pp. 240. \$4.00.

Although the title indicates that this is a book for boys, I would say that anyone who is interested in amphibians will find this small volume both interesting and enlightening. The author, Mr. Percy A. Morris, Chief Preparator of the Peabody Museum in New Haven, has a large fund of first hand information concerning frogs, toads and salamanders, and he is able to convey this information to others in a clear and forceful way.

The book describes and illustrates by photographs nearly all the various kinds of amphibians that may be found in the United States. It tells where to find them, how to capture them, how to handle them, how to identify them, and how to raise them in captivity. It is worth acquiring for any high school library.

*H. J. Kline, C.S.Sp.
Dept. of Biology
Duquesne University*

Photo by Vic Kelley

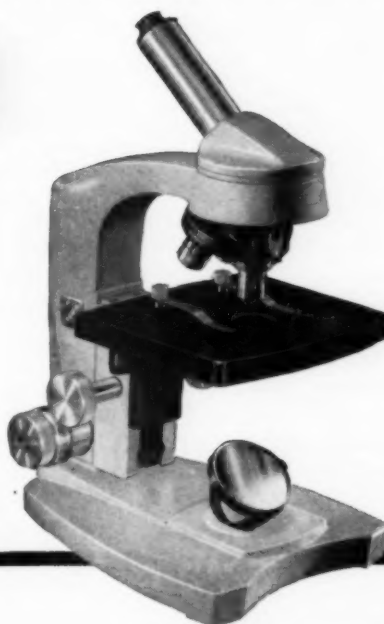


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Ernest Rutherford

• *By* JOHN ROWLAND. New York: The Philosophical Library, Inc. 1957. Pp. 160. \$4.75.

Recent surveys of the attitudes of students towards science indicate the belief that scientists are uninteresting and dull persons, causes some to avoid seeking a career in science. The source of this unfavorable concept of the scientist is unknown, and the best refutation of this view is the life story of Ernest Rutherford.

Those whose knowledge of Rutherford is limited to his scientific achievements will be happy to learn that he had an excellent sense of humor and that he was a humble man. John Rowland not only presents a pleasing view of his boyhood and family life, but also portrays him as an inspiring director of many young men who were later to make great names for themselves. P. M. Blackett, Chadwick, Crockcroft, Geiger, Kapitza, Mosely, Oliphant, Walton and many others were associated with him.

We recommend this brief biography of Ernest Rutherford to all who are interested in a scientific career.

J.P.M.

Man Against Germs

• *By* A. L. BARON. New York: E. P. Dutton and Co., Inc. 1957. Pp. 320. \$4.50.

While the history of the diseases of man is an extremely fascinating study, books on the history of disease tend to be lengthy and dry. Doctor Baron has

limited himself to a consideration of thirteen diseases of man. The result is an easily-readable and informative book.

Cholera, tuberculosis, leprosy, bubonic plague, syphilis, typhoid fever, dysentery, poliomyelitis, smallpox, yellow fever, influenza, typhus and rickettsial diseases are covered. Their history, nature, and man's steps in the conquest of these diseases are treated.

The reader, who is not well-acquainted with the field, will acquire an accurate picture of the significance of diseases in the history of man and an appreciation of the advances of medical science. Those who are well-acquainted with the field will also find the book informative. We recommend *Man Against Germs* for the high school and college library.

★ ★ ★ ★ ★

AAAS Expands Teaching Improvement Program

In an effort to achieve the goals of its Science Teaching Improvement Program, the American Association for the Advancement of Science has appointed twenty regional consultants in science and mathematics to serve colleges and universities. Upon invitation, the scientists assigned to an area will arrange to call upon a college or university and meet with staff members in education and science to consider the problems of teacher education. I. M. Wallen, assistant director of STIP, suggests the following ways in which these consultants may be helpful:

1. Suggest ways in which institutions of higher learning might maintain closer working relationships with science and mathematics teachers in secondary schools.
2. Review possibilities for achieving greater awareness of the need for strong programs in science and mathematics on the part of the general public, school boards, and school administrators.
3. Take part in the discussion of programs to interest more young people in the study of science and mathematics, and the preparation for careers in science, engineering and teaching.
4. Seek information about promising programs which can be shared with other consultants and with STIP headquarters.
5. Consider ways in which the AAAS, through STIP and other activities, may be of assistance in the improvement of science teaching.

STIP is an action program designed to increase the number of well-qualified science and mathematics teachers at the secondary school level. It was established in 1955 through a grant to the AAAS from the Carnegie Corporation of New York and is under the direction of John R. Mayor, on leave from the University of Wisconsin. The regional consultant service has been made possible by funds contributed by the General Electric Educational and Charitable Fund. For a list of the regional consultants and the areas covered by each, write to Dr. I. M. Wallen, AAAS, 1515 Massachusetts Ave., N. W., Washington 5, D. C.

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Basic Data on Cancer

1. What is cancer?

Cancer is a group of diseases characterized by uncontrolled growth and spread of cells. If this malignant process is not controlled or checked, the outlook for the patient is usually poor. However, many cancers can be cured if detected early in their development and treated by surgery or radiation.

2. How cured?

The only approved methods of curing cancer today are radiation or surgery. However, in the treatment of certain types of malignant growth, hormones, certain drugs and some radioactive substances have proved extremely valuable.

No cancer was ever cured by any quack or "wonder doctor" using a "secret" method, gadget or medicine.

3. Who will get cancer?

Cancer can strike anyone at any age. It can affect children as well as adults.

Cancer will strike one in every four Americans now living, according to present rates.

More than 40,000,000 Americans now living will eventually have cancer.

Cancer will strike in approximately two of every three American families.

4. National death rate and note on lung cancer.

There has been a steady rise in the national cancer death rate since 1934. In 1934 the number of cancer deaths per 100,000 population was 106; in 1940 and 1941 it was 120; by 1947 it had risen to 132; and in 1953 the number was 145. For 1955 the estimated rate was 148, with about 242,000 dying of cancer.

Except for lung cancer, cancer death rates in general are leveling and in some cases dropping off. Lung cancer, the chief cause of cancer death in men, killed approximately 24,500 men and 4,500 women last year. The total of 29,000 deaths is about six times as many as 20 years ago.

5. How many die?

Last year about 250,000 Americans died of cancer.

This year about 255,000 Americans will die of cancer.

Out of every six deaths from all causes in the United States, one is caused by cancer.

Approximately 700 Americans die of cancer every day.

Cancer kills one man, woman or child every two minutes in the United States.

6. How many with cancer?

This year 700,000 Americans will be under medical care for cancer.

7. New cases annually.

There will be about 450,000 new cancer cases (diagnosed for the first time) in 1957.

8. Now saving 1-in-3.

One cancer patient in every three is now being saved. This means that of every six persons who get cancer, two will be saved and four will die.

Nos. 1 and 2 will be saved.

No. 3 will die needlessly. He could have been saved if proper treatment had been received in time.

Nos. 4, 5 and 6 will die of cancers which cannot yet be controlled.

This means that today half of those who get cancer could and should be saved.

9. How many saved?

About 150,000 Americans will be saved from cancer this year. About 150,000 were saved last year.

The gain in lives saved from one-in-four to one-in-three amounts to some 30,000 patients each year.

About every four minutes another American who had cancer is saved.

10. How many could be saved?

About 75,000 cancer patients will die in 1957 who might have been saved by earlier and better treatment. Another 75,000 could have been saved last year.

Of all Americans who die with cancer today, the deaths of one-fourth could be avoided if proper treatment were begun in time.

11. Cancer deaths by age.

In 1956 there were more than 20,000 cancer deaths of patients aged 15 to 44.

Half of all cancer deaths last year were among Americans under age 65.

12. Cancer deaths by sex.

More men than women died of cancer last year. This has been true since 1949. The proportion was about 52 to 48.

13. Cancer and children.

Last year cancer took the lives of more than 4,000 children under 15 years old. About half of them died of leukemia.

Last year more school children died of cancer than from any other disease.

Today there are more than 160,000 American children under 18 who have lost their fathers to cancer. More than 175,000 have lost their mothers.

14. Hospital bill for cancer.

The annual hospital bill for cancer is estimated at about \$300,000,000, or ten times what the ACS is asking the public to give to fight cancer in 1957.

15. Facilities for treatment.

Since 1945, facilities for the treatment of cancer have increased by about 63 per cent.

16. The health checkup.

Many thousands more could be saved if men and women would have a complete medical examination once a year.

Checkups are becoming more popular. An ACS survey shows that the number of Americans having checkups has more than doubled since 1948.

Of 1,000 women more than 45 years old entering a doctor's office, 18 are likely to have cancer.

Of 1,000 men over 45 entering a doctor's office, 17 are apt to have cancer.

17. **Lives saved . . . table of percentages for six leading sites.**

The table of estimates below is based on reports to the Third National Cancer Conference that included comprehensive data from the Connecticut State Department of Health, as well as the records of many hospitals, clinics and other medical sources. The figures are believed to be sound estimates for most of the U. S.

Cancer	Percentage of patients now being saved.	Patients saved when diagnosed early and properly treated. (Per cent)
Uterine	55	70
Breast	46	81
Rectal	25	77
Mouth	36	65
Skin	90	95
Lung	4	34

("Saved" is used to mean that the patient has been treated for cancer and is alive five years later. Most such cases are permanently cured.)

18. **The danger signals.**

Between checkups, be alert for cancer's danger signals. Appearance of any of these symptoms may or may not mean cancer. But it should always mean a visit to your doctor. The danger signals are:

1. Unusual bleeding or discharge.
2. A lump or thickening in the breast or elsewhere.
3. A sore that does not heal.
4. Persistent change in bowel or bladder habits.
5. Persistent hoarseness or cough.
6. Persistent indigestion or difficulty in swallowing.
7. Change in a wart or mole.

—From: 1957 Cancer Facts and Figures

National Science Foundation to Support After-School-Hours Training for Science Teachers

The National Science Foundation announced today that it will accept proposals to support on an experimental basis about 15 In-Service Institutes for Secondary-School Teachers of Science and Mathematics to be held during the academic year 1957-58. Summer and academic-year institutes are presently operating in 111 colleges and universities throughout the Nation with support from the Foundation.

In-Service Institutes for Secondary-School Teachers of Science and Mathematics will offer work in the subject matter of science or mathematics especially designed for secondary-school teachers. Institute meetings will be held outside regularly scheduled school hours—e.g. evenings, Saturdays, or late afternoons—so that teachers may attend while still teaching full time in their schools. A typical institute might meet once a week for two hours with perhaps half the meetings devoted to laboratory work, for the full academic year of about 30 weeks.

Past experience has indicated that most secondary-school teachers desire academic credit, preferably graduate credit, for work successfully completed at the institutes. If such credit were given for an in-service institute, it might amount to two credit hours per semester, or four per year. Such credit would, of course, be only at the discretion of the host institution.

The In-Service Institute program contemplates that each group will be kept to about 15 members so that discussion may be full and free.

It is hoped that in-service institutes may be established by many of the smaller, excellent colleges and universities outside metropolitan areas, as well as by larger institutions in urban centers, in order that teachers in outlying school districts may enjoy the advantages of training facilities not otherwise readily accessible to them.

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NO TRANSFER BODIES—In all conventional influence machines, whether of Holtz or Wimshurst type, electrical charges are collected and conveyed (from rotating plates to electrodes) by a system of "transfer bodies." Such bodies have always taken the form of metal brushes, rods, button disks or segments—each of which, inevitably, permits leakage of the very charge it is intended to carry, and thereby sharply limits the maximum output voltage.

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DISCHARGE TERMINAL Charges accumulate on, and discharge takes place from, the outer surface of a polished metal "sphere"—or, more accurately, an oblate spheroid.

The upper hemisphere is flattened at the pole to afford a horizontal support for such static accessories as must be insulated from ground. A built-in jack, at the center of that horizontal area, accepts a standard banana plug. Connections may thus be made to accessories located at a distance from the GENATRON.

CHARGE-CARRYING BELT To the terminal, charges are conveyed by an endless band of pure, live latex—a Cambosco development which has none of the shortcomings inherent in a belt with an overlap joint.

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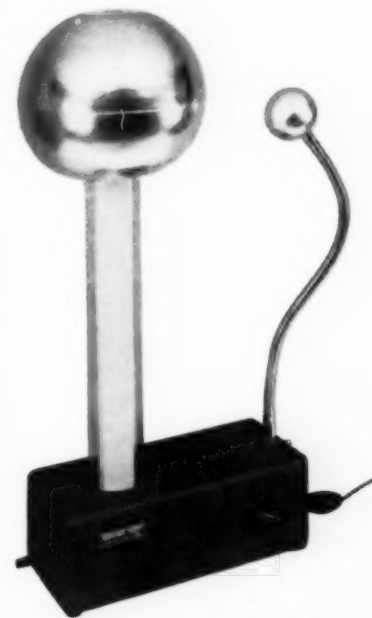
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